ARMY RESEARCH LABORATORY

A Compilation of Data Relative to the Future Design of the Combat Vehicle Crewman's Helmet DH-132

Thomas H. Oblak
Samson V. Ortega, Jr.

ARL-TN-31 December 1993

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REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	December 1993	Final

4. TITLE AND SUBTITLE

A Compilation of Data Relative to the Future Design of the Combat Vehicle Crewman's Helmet DH-132

5. FUNDING NUMBERS

PR: AH70
PE: 62716

6. AUTHOR(S)

Oblak, T. H.; Ortega, S. V. Jr.

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

U.S. Army Research Laboratory
Human Research & Engineering Directorate
Aberdeen Proving Ground, MD 21005-5425

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

U.S. Army Research Laboratory
Human Research & Engineering Directorate
Aberdeen Proving Ground, MD 21005-5425

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

ARL-TN-31

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT

Approved for public release; distribution is unlimited.

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

A study was conducted to provide information about the combat vehicle crewman helmet, DH-132, to the U.S. Army Natick Research, Development, and Engineering Center (NRDEC). The Human Research and Engineering Directorate (HRED) of the U.S. Army Research Laboratory (ARL) collected data, including compatibility, comfort, fit, safety, protection, steady state and impulse noise, about the DH-132 and the types of vehicles and radios in which the helmet is used. The information and user feedback in this report will be used for a future design of the advanced prototype combat vehicle crewman helmet by NRDEC.

14. SUBJECT TERMS

combat vehicle
crewman's helmet
DH-132
helmet

15. NUMBER OF PAGES

106

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	

AMCMS Code 612716H7000011 Technical Report ARL-TN-31

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A COMPILATION OF DATA RELATIVE TO THE FUTURE DESIGN OF THE COMBAT VEHICLE CREWMAN'S HELMET DH-132

INTRODUCTION

At the conclusion of Operation Desert Storm (ODS), shortcomings were noted with the first extensive war-time use of the combat vehicle helmet DH-132 (see Figure 1), which was introduced in 1976. The helmet was uncomfortable and hot after extended wear in the desert. The helmet needs improvements in its communication system and more options for sizing. After the reported death of a tank commander, who was hit in the helmet by shrapnel, the combat developers wanted more ballistic protection. In addition, some sort of maxilla facial protection is desired to reduce bump injuries to the face.

In anticipation of funding for a joint program to develop a new combat vehicle crewman (CVC) helmet, the U.S. Army Natick Research, Development, and Engineering Center (NRDEC) requested the Human Research and Engineering Directorate (HRED) of the U.S. Army Research Laboratory (ARL) to collect data to support a development program designed to replace the current DH-132. The developers at NRDEC needed information about the current use of the DH-132 and some user feedback. Since the only background information about the development of CVC helmets was McKenzie (1969), NRDEC needs updated information. The objectives of this study are to

1. Determine the compatibility of the helmet with current and near-term vehicle crew stations;

2. Identify current and future vehicles in which the CVC DH-132 helmet is and will be worn;

3. Identify the communication systems that currently interface with the CVC DH-132, including dismounted radios;

4. Provide the available steady state and impulse noise data from various crew stations to establish the aural protection required for a helmet user;

5. Determine what eye and maxilla facial protection data are required for the combat vehicle crewman;

6. Provide user feedback concerning the comfort and fit of the CVC DH-132 helmet; and

7. Provide injury data and safety concerns applicable to the CVC helmet.

APPROACH AND RESULTS

There was a unique approach for each area. The approach and results follow.

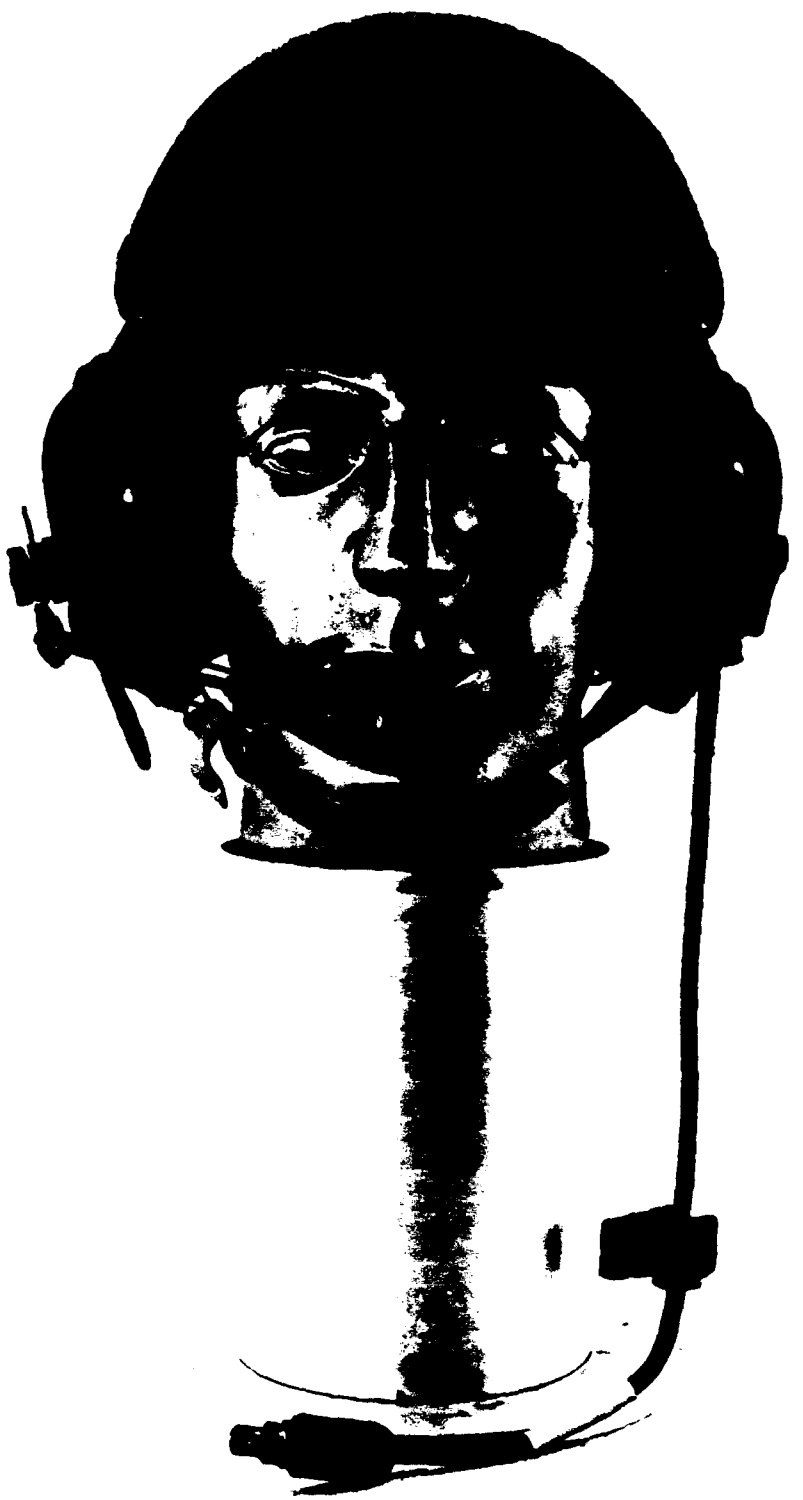

Figure 1. CVC DH-132 helmet.

Compatibility of the CVC DH-132 Helmet With Current and Near-Term Vehicle Crew Stations

Approach

Three approaches were taken. First, a user questionnaire (see Appendix A) was used to gather information from soldiers who wear the CVC. The questionnaire was given to soldiers of the 2nd Brigade, 1st Infantry Division, stationed at Ft. Riley, Kansas, who had just completed a National Training Center (NTC) rotation. Two hundred fifty-three (253) soldiers participated and represented every unit in the division that uses armored vehicles. An assumption was made that these soldiers would draw from that recent training experience at the NTC when answering the questionnaire. However, it was recognized that other experiences might also influence their responses. For instance, more than half of these soldiers had participated in Operation Desert Storm as armored vehicle crewmen.

The second approach was to consult with the HRED Crew Station Integration Team for their opinion about the impact of the current CVC DH-132 configuration on future and near-term armored vehicles.

Third, the Bradley fighting vehicle (BFV) Systems Team of the U.S. Army Tank-Automotive Command (TACOM) was consulted about the available mechanical drawings of the current and future sighting systems on armored vehicles, which may interact with the CVC DH-132 helmet.

Results

The questionnaire results (see Appendix A) indicated that the current helmet physical configuration (excluding the communication system) interacts well with most work stations of the 1st Infantry Division's armored vehicles.

During the debriefing of soldiers from the 1st Infantry Division, several explained a problem with the interaction of other devices (i.e., night vision goggles (NVG); regular sand, wind, and dust goggles; and the NOMEX hood), which are needed in the operation of the unit's vehicles. The NVGs are worn by the vehicle commander during movement as an aid to the driver who has a night vision device attached to a periscope slot in the driving compartment. The commander is supposed to wear the head harness for the NVG (AN/PVS-7 or AN/PVS-5). However, the tight fit of the helmet makes the harness uncomfortable, and the commander often holds the goggles in his hand and uses them like binoculars. Therefore, his hands are not always free to brace himself or use the controls in an M1 Abrams tank or M2 BFV at the commander's station. Several soldiers also said that the regular sand, wind, and dust goggles do not seal properly on the face, thus allowing sand or dust to get into the eyes of the wearer, causing a safety hazard. Also, several soldiers said that the NOMEX hood is made of a heavy material, and the helmet fits tightly on the wearer's head. As a result, hearing sensitivity is reduced and the level of discomfort is increased.

Artillerymen

The primary complaint of the 41 artillerymen surveyed in the study is that while they wore the CVC during firing, the "spaghetti cords" (communication cables) got in the way when the artillerymen operated inside the vehicle. The cords, which hang down from the radio and are connected to the helmet, get caught on equipment inside the cannon turret housing.

In the opinion of the HRED Crew Station Integration Team, the CVC helmet in its current configuration will not pose any problems with near-term vehicles. Future "two-person crew" vehicles will probably use video monitors for driving and sighting, which will greatly reduce any interaction between the helmet and the sighting systems. Both crew members are seated at least 2 feet from the monitors they are required to watch. Current vehicles use sight reticles and brow pads that interact directly with the helmet or soldier's eyes and forehead.

FMC (formerly Farm Manufacturing Company), General Dynamics (Land Division), TACOM, and the Directorate of Combat Developments at the Armor Center, Fort Knox, Kentucky, were contacted to provide input about the impact of helmets on future vehicles. Their opinions reinforced the HRED Crew Station Integration Team's description of future vehicle design.

Appendix B contains drawings of current sighting systems on the M2 BFV. TACOM provided these drawings to show the depth and breadth measurements that need to be considered if the Army designs a new CVC helmet.

Identity of Current and Future Vehicles in Which the CVC DH-132 Helmet will be Worn

Approach

Army Regulation (AR) 738-50 (Headquarters, Department of the Army, 1991) was reviewed to identify the current armored vehicles in which the CVC DH-132 helmet is worn and to determine the future armored vehicles in which the CVC helmet will be worn. In addition, information was received from the weapons systems managers of TACOM and the Tracked Vehicle Branch of the U.S. Marine Corps Logistics Agency of Albany, Georgia, to ensure completeness of the list.

Results

Table 1 is divided into two segments. One segment lists armored vehicles belonging to the U.S. Army and the U.S. Marine Corps (USMC). This list also contains the future armored vehicles in which the CVC helmet will be worn. The other segment contains armored vehicles that are specifically for the USMC. The USMC is not planning a future armored vehicle. The DH-132 is compatible with all the vehicles.

Communication Systems That Currently Interface With the CVC DH-132 Helmet, Including Dismounted Radios

Approach

The developer wanted to know what radios are commonly used in armored vehicles. The goal was to identify the communication systems that currently interface with the CVC DH-132 helmet. The following armored vehicle technical manuals (TMs) were examined: TM 9-2350-264-10-2, Tank, Combat M1A1; TM 9-2350-284-10-2, Fighting Vehicle, Infantry M2A2; TM 9-2350-311-10, Howitzer, Medium Self-propelled (SP) 155mm M109A4; and TM 9-2350-261-10, Carrier, Personnel M113, M557, M106, M125.

Table 1

U.S. Army and USMC Armored Vehicles

Model number	Nomenclature
	Current Armored Vehicles
M1/M1IP/M1A1/M1A2	Tank combat, full
M2/M2A1/M2A2	Infantry fighting vehicle
M3/M3A1/M3A2	Cavalry fighting vehicle
M5	Bulldozer
M9	Tank, bulldozer (armored combat engineer [ACE])
M48A2/M48A5 AVLB	Launcher, bridge
M60A1 AVLB	Launcher, bridge
M60/M60A1/M60A2	Tank combat, full
M60A1 (RISE)A3	Tank combat, full
M60A1E3/M60A1PAS	Tank combat, full
M60A3 (TTS)	Tank combat, full
M88A1	Recovery vehicle
M106A1	Carrier, self-propelled 107mm mortar
M107	Gun, self propelled
M109A1/M109A2	Howitzer, self propelled
M109A3/M109A3E2	Howitzer, self propelled
M110A1/M110A2	Howitzer, self propelled
M113A1/M113A2/M113A3	Carrier, personnel
M125A2	Carrier, mortar, 81mm
M548/M548A1	Carrier, cargo
M551A1	Armor, reconnaissance, assault vehicle
M577A1/M577A2	Carrier, command post
M578	Recovery vehicle
M667	Carrier, missile, LANCE
M728	Combat engineer vehicle
M730/M730A1/M730A2	Carrier, guided missile
M901	Improved tube-launched, optically tracked, wire-guided (TOW) vehicle
M973	Carrier, cargo
M992	Carrier, ammunition
M992	Carrier, cargo
M1015	Carrier, signal Intel/electronic warfare (EW)
M1050	Carrier, ammunition
M1059	Carrier, smoke generator
M1065	Carrier, cargo
M1066	Carrier, cargo
M1067	Carrier, cargo
FOX	Armored nuclear, biological, chemical (NBC) reconnaissance vehicle
M270	Multiple launch rocket system (MLRS)
M741A1	Vulcan
M992	Field artillery armored support vehicle (FAASV)
	Future Family of Vehicles (FFV)
Block II tank (M1 System)	
Block III tank	
Armored gun system	
Line of sight/antitank (LOSAT)	
Future infantry fighting vehicle (FIFV)	
Product improvement plan (PIP) for Bradley optics	

Table 1 (continued)

Model number	Nomenclature
	USMC Specific Armored Vehicles
	Light Armored Vehicle (LAV)
LAV 25	Reconnaissance vehicle
LAV C2	Command and control
LAVM	81mm mortar
LAVR	Recovery vehicle
LAVAT	Antitank TOW
LAVL	Logistic vehicle
	Amphibious Assault Vehicles (AAV)
AAV P7A1	Personnel carrier
AAV C7A1	Command and control
AAV R7A1	Recovery vehicle

Results

Table 2 is a list of communication equipment in armored vehicles, all of which is compatible with the CVC, for both the U.S. Army and the USMC. The CVC helmet is connected through a quick disconnection that is common to all the radio sets.

Table 2

Communications Equipment on Armored Vehicles, U.S. Army and USMC

Radio Set VRC 12 (AN/VRC 46, AN/VRC 47, AN/VRC 64)
Radio Set AN/VRC 54
Radio Set AN/VRC 89
Radio Set AN/VRC 114
Radio Set AN'ARC 131
Radio Set AN/GRC 39
Radio Set AN/GRC 160, includes the (PRC-77) dismounted radio
Radio Set AM/1780
Radio PRC-126
Radio Set single-channel ground/airborne radio system (SINCGARS) AN/GRC 213
Multi-subscriber equipment
INTERCOM's C-10456/2298
Secure device, KY 57

Available Steady State and Impulse Noise Data From Various Crew Stations

Approach

The U.S. Army Combat Systems Test Activity (CSTA) at Aberdeen Proving Ground (APG) has conducted several acoustical studies about various armored vehicles to evaluate hearing protection requirements (see Appendix C).

The information was collected during a variety of vehicle conditions (i.e., hatches opened, closed, engine idling, vent blowers on or off, etc.), vehicle positions (i.e., driver, commander, gunner, cargo, etc.), types of roads, and various weather conditions.

Results

A list of armored vehicles for which steady state and impulse noise data have been collected is given in Table 3. The peak threshold for steady state noise is 131 dB and for impulse noise, 189 dB. Detailed results from CSTA tests for each vehicle are contained in Appendix C.

Table 3

Armored Vehicles for Which Steady State and Impulse Noise Data Have Been Collected

Vehicle type	Available acoustical data		High end level (dB)
	steady state	impulse	steady state/impulse
M60 Tank combat, full	X	X	128/169
M1A1 Tank combat, full	X	X	122/180
M2A2 Infantry fighting vehicle	X	X	129/168
M2A1 Infantry fighting vehicle	_a	X	/168
M109A3 Howitzer, self propelled	X	_a	120/
M109A2 Howitzer, self propelled	_a	X	/149
M110A2 Howitzer, self propelled	X	X	119/170
M741A1 Vulcan	X	X	130/137
M270 Multiple launch rocket system	X	X	131/125
M992 FAASV	_a	X	/134
M9 Bulldozer ACE	X	_a	112/
M901 Improved TOW vehicle	_a	X	/156
LAV 25	X	_a	116/

_a Acoustical data not available.

Eye and Maxilla Facial Protection Data Required for the Combat Vehicle Crewman

Approach

A literature review was conducted to determine the availability of information regarding eye protection and the need for eye protection in armored vehicles or when CVC helmets are worn. The ARL library conducted the search, referencing helmet wear in armored vehicles, eye protection for armor vehicles and eye protection with helmets. There is no known document that relates specifically to eye protection for the CVC. However, Hickey (1986) was referenced to determine the need for ballistic eye protection for combat personnel in general. As a note, armored vehicle crewman are issued goggles that are used to reduce the effects of sand, wind, and dust.

There are no known data that relate to the maxilla facial protection for the CVC. The only data that relate to injuries, as a result of wearing the CVC without any maxilla facial protection, are available from the U.S. Army Safety Center (USASC) at Fort Rucker. This is discussed in Appendix D.

Discussion

The need for ballistic eye protection was established by a tri-service joint working group (JWG) for eye armor in 1982. The group concluded that most disabling eye injuries can be prevented by providing some form of polycarbonate eye armor. They also concluded that personnel wearing corrective eyewear were afforded some level of eye protection. Since 80% of U.S. combat arms personnel do not require corrective eyewear because they have normal vision, they are at greatest risk (Hickey, 1986).

User Feedback Concerning the Comfort and Fit of the CVC DH-132 Helmet

Approach

To obtain the user feedback concerning the comfort and fit of the CVC DH-132 helmet, ARL relied on the responses to the questionnaire (see Appendix A) that was given to the 253 soldiers of the 2nd Brigade, 1st Infantry Division stationed at Ft. Riley, Kansas (see Table 4). Their responses were sorted by category (i.e., comfort, performance, etc.) and are listed in the Results section.

Table 4

Some Demographics of the Questionnaire Participants

MOS	Number responding	RANK	Number responding	Months wearing helmet	Number responding	Type vehicle	Number responding
Infantry	69	PVT/PFC	81	1 to 6	47	M1	49
Engineer	23	SPC/CPL	95	7 to 12	45	M2/3	75
Artillery	41	SGT	43	13 to 18	35	M9	4
Armor	60	SSG	15	19 to 24	29	AVLB	1
Communicator	2	SFC	3	more than 24	84	M109	16
Mechanic	11	LT	6			M113	30
NBC	10	CPT	2			M557	6
Medic	17					M578	5
Other	11					M728	3
						M992	1
						M993	10
						M1059	2
						OTHER	32

Average age 23.5
Average weight 176 pounds
Average height 69 inches
Average time in a vehicle 23 months
Average time wearing helmet 20 months

Results

The responses to the questionnaire were collated into seven categories that best represent an evaluation of comfort and fit requirements for the CVC DH-132 helmet. Table 5 is a categorized list of the collated concerns and comments provided by the soldiers.

Table 5

Collated Concerns and Comments of the Soldiers

	Percentage of total respondents
Concerns about comfort:	
The helmet is uncomfortable when worn for extended periods	42%
Hot to wear in warm weather	39%
Not always getting the right size	25%
Cords become disconnected	11%
Boom microphone gets caught	10%
Spaghetti cords get in the way, especially for artillery vehicles.	8%
Concerns about performance:	
Hard to hear anyone over engine noise	44%
Can't talk to anyone inside the vehicle when outside the vehicle	20%
Communication problems, difficult to maintain	15%
Standard items worn under the CVC:	
NOMEX Balaclava	worn by all
Cold weather items, ski mask, pile cap, wool scarf, etc.	worn by all
Scarf for dust	worn by all
Goggles	worn by all
Glasses	worn by all
NVG harness	worn by all
Protective mask	worn by all
Problems with sighting systems:	
Tilting of the helmet to properly sight in	35%
Using NVGs is difficult	18%
Helmet rests on brow pad	12%
Boom Microphone gets in the way of sighting	2%
Looking at the ground positioning system readout in an M1A1 is difficult with the CVC	1%
Goggles and multiple integrated laser engagement system fall off when looking through the sights	1%
List of concerns with the use of a possible ballistic facial protection and sighting systems:	
Protective mask must fit underneath	100%
M1 and M2 gunners and commanders are concerned with peripheral vision loss	100%
Facial protection is needed	30%
Concerns with correct alignment with the sights	20%
Facial protection would get in the way	15%
Would be OK if removable	4%
Make it see through	3%

Table 5 (continued)

Compiled suggestions to improve the CVC:

Improve comfort
Built-in sun and eye protection
Cooler, more ventilation and circulation. Could you vent from the NBC system?
Make it lighter, it's already heavy enough. Helmet could get heavier if it got more comfortable
More padding (non-specific)
More size options, currently one size fits all (Air up system)
More ballistic protection. Especially for the vehicle commander
Issue the helmet as personnel equipment, not as part of the vehicle
Neck protection (non-specific)
Air holes, air vents, in the helmet for cooling
More cushion around the ears
Adjustable ear cups
Chin strap redesign, reduce chaffing
More durable (non-specific)
Facial protection
Facial protection is not needed for every position, make it removable
See through facial protection, to prevent loss of field of view
Wireless communication system between helmet and vehicle
More reliable communication system
Better boom microphone, fewer moving parts
Better disconnect between the plugs on the helmet with the cords to the vehicle
Ear plug type speakers

Other concerns:

Goggles: Better fit, attach to helmet
NVG (PVS-7B), attachment for the helmet
Consider soldiers who wear glasses
Incorporate MILES head harness

Injury Data and Safety Concerns Applicable to the CVC Helmet

Approach

ARL asked the U.S. Army Aeromedical Research Laboratory (USAARL) to provide information regarding head injury information for the CVC helmet. To provide the requested information, ARL conducted a data search detailing injuries from the USASC data base for head injury in vehicles in which a CVC was worn. In addition, ARL solicited questionnaires and received briefings about the the M1 Abrams tank and the M2 BFV at the unit training equipment site at Fort Rucker and at the 1st Battalion, 29th Infantry at Fort Benning (see Appendix D). This was done in an effort to gain first-hand knowledge of the environment for a CVC helmet wearer.

Another source was the questionnaire (see Appendix A) completed by the soldiers of the 2nd Brigade, 1st Infantry Division, of Ft. Riley, Kansas. (Most of the responses are verbatim, as written by the soldiers.)

Results

The information provided by ARL indicated that during an 8-year period, approximately 23% of 2,902 serious armored vehicle mishaps resulted in head or facial injuries. Because the injury report form is not detailed, it is not known if a CVC helmet was worn during the time of the injury, because the person may have been wearing a ground soldier's helmet. The results of the 2,902 mishaps include 31 deaths, 643 non-fatal injuries, and more than 15,000 lost work days for the U.S. Army. The types of injuries included lacerations, skull and facial fractures, concussions, and burns. ARL suggested that a follow-up study could determine the risk of head and face injuries for armored vehicle crewmen, by expanding and detailing this current report. Note. Not all injuries to armored vehicle crewmen are reported. In the authors' opinion, only those injuries of substantial severity tend to be reported.

Table 6 is a list of subjective comments obtained from the 41 soldiers who responded to the "head injury" question on the questionnaire (*"If you have ever had a head injury of any type or severity (including the face), briefly explain"*).

Table 6

Comments From Soldiers Who Answered the "Head Injury" Question

Soldiers' responses (41 total)	Number of respondents	(Percent of the 41 who responded)
Cut chin or face while driving in rough terrain	13	32.0%
Headaches from wearing the helmet too long	10	25.0%
Just bugs, dust, rain, hail, rocks, tree branches, and snow hitting the face while driving	8	20.0%
Ears got sore with prolonged use	4	10.0%
Hit eyes or chin on the sights during sudden stops	4	10.0%
Minor bumps on the head	5	12.5%
Bumped nose inside the vehicle	5	12.5%
50-cal. mount swung around and hit face (some broke their noses)	4	10.0%
Teeth broken after hitting edge of vehicle's 50-cal. mount	4	10.0%
Hit my lip several times when making quick stops	3	7.5%
Bottomed out the vehicle going down hill; hit face on the front of the driver's hatch	2	5.0%
Once wrecked an armored vehicle launched bridge (AVLB) (M48) while towing another in the collision, I hit my jaw into the hatch and cracked my CVC cover on the backlash	1	2.5%
The goggles don't seal; get sand in my face	1	2.5%

Table 6 (continued)

Soldiers' responses (41 total)	Number of respondents	(Percent of the 41 who responded)
Accelerator stuck on Bradley and it ran into a ditch; driver suffered a frontal super orbialal fracture and fractured sinus	1	2.5%
Hit periscopes inside driver's hatch after landing	1	2.5%
Thrown into the hatch hole several times while driving in the dark. Face took the brunt of the blow.	1	2.5%
Bumped head hard on the brow pad	1	2.5%
Hit a ditch, face bumped the hatch at the boom microphone. Only minor injury, but if the vehicle had been going faster, would have lost some teeth.	1	2.5%
Driving around at night, got bumped on the head, the hatch latch poked through at the ear cup	1	2.5%
Hit face on the external machine gun mount	1	2.5%
Scratched eye because of low branches	1	2.5%
Broke jaw when the vehicle hit a ditch	1	2.5%
I would rather suffer with the same little problems than get my tank killed because some face protector prevents my gunner or me (TC) from getting a good quick sight picture of the enemy--comment from a Desert Storm veteran	1	2.5%
Driving at night, I hit my nose on the night sight (VVS-2), causing a bloody nose	1	2.5%

SUMMARY

With only one type of helmet to base opinions upon, it is difficult to conduct an analysis of the DH-132. Most of the information requested by NRDEC was already available. This report compiles that requested information.

From the available data relative to the design of the CVC DH-132 helmet, the current helmet design appears to fulfill its intended use for most of the armored vehicles. The current helmet has some incompatibilities with a few armored vehicles and with certain personal equipment (i.e., NVG, sand and dust goggles, etc.).

The area where a major design change should be made in the CVC helmet includes maxilla facial protection. The injury data in Appendix D and the results of the questionnaires in Appendix A indicate that several deaths and non-fatal injuries resulted when the current CVC helmet was worn. These refer only to substantially severe injuries. Therefore, the total number of injuries is probably much greater. Also, the number of comments from the soldiers of armored vehicles who had some sort of injury while wearing the CVC

helmet further indicates that improvements need to be made to enhance facial protection. Most of the injury comments related to facial injuries (i.e., broken teeth, cut chin, bumped nose, etc). There is also a strong indication that some sort of eye protection needs to be considered in a future helmet. Eye protection is a major concern throughout the Army community, especially laser protection.

Design changes should be made to provide the CVC helmet with eye and maxilla facial protection while allowing the wearer to use the sighting systems of current and future armored vehicles, without interference, as suggested by the comments provided by soldiers. Changes in the DH-132 and or the design of a future CVC helmet should also consider the compatibility of the helmet with current and future NVGs, goggles, and the protective mask.

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APPENDIX A

USER FEEDBACK QUESTIONS AND ANSWERS

USER FEEDBACK QUESTIONS AND ANSWERS

Note. The number after each answer is the number responding for that question.

1. What is your primary military occupation speciality (MOS)?

11 (Infantry)/**69**	12 (Engineer)/**23**	13 (Artillery) /**41**
19 (Armor)/**60**	27 (Air Defense)/**0**	31 (Communications)/**2**
43 (Ordnance)/**0**	44 (Ordnance)/**0**	54 (Chemical)/**10**
63 (Ordnance)/**11**	76 (Quartermaster)/**0**	88 (Transportation)/**0**
91 (Medical)/**17**	92 (Intelligence)/**1**	Other/**11**

2. What is your duty MOS?

11/**69**	12/**24**	13 /**41**	19/**59**	27/**0**	31/**2**
43/**0**	44/**0**	54/**10**	63/**11**	76/**0**	88/**1**
91/**16**	92/**1**	Other/**10**			

3. What is your age? **The average age was 23.69 years old.**

4. What is your rank?

0 PVT/PFC/**81**	0 SPC/CPL/**95**	0 SGT/**43**	0 SSG/**15**	0 SFC/**3**
0 LT /**6**	0 CPT/**2**			

5. What is your weight (in pounds)? **Average weight was 176 pounds.**

6. What is your height? **Average height was 69.3 inches.**

7. How long have you been in the Army?

0 1-12 Months/**18**
0 13-24 Months/**70**
0 25-36 Months/**67**
0 4-6 years/**34**
0 Over 6 years/**45**

Average time in the Army, just over 4 years.

8. What size CVC helmet, DH-132 do you wear?

0 Small/**24**	0 Medium/**159**	0 Large/**58**

9. How long have you been wearing the helmet CVC DH-132?

0 1-6 Months/**47**
0 7-12 Months/**45**
0 13-18 Months/**35**
0 19-24 Months/**29**
0 Over 24 Months/**84**

Average months wearing the helmet is 20.

10. What type vehicle are you a crew member in (answer more than one if applicable)?

0 M1/**49** 0 M2/**61** 0 M3/**14** 0 M9/**4** 0 M48 AVLB/**1**
0 M60A3/**1** 0 M109/**16** 0 M113/**30** 0 M557/**6** 0 M578/**5**
0 M728/**3** 0 M992/**1** 0 M993/**10** 0 M1059/**2** 0 Other /**32**

11. How long have you been working with this vehicle(s)?

0 1-6 Months/**37**
0 7-12 Months/**36**
0 13-18 Months/**33**
0 19-24 Months/**37**
0 Over 24 Months/**100**

Average time in a vehicle, 23 months.

12. What is is your crew position?

0 Vehicle Commander/**60**
0 Gunner/**50**
0 Driver/**101**
0 Loader/**5**
0 Observer/**5**
0 RTO/**6**
0 Other/**15**

13. Are you issued the Kevlar, PASGT, ground soldier's helmet?

0 Yes/**234** 0 No/**11**

14. Do you ever wear the Kevlar, PASGT Helmet in conjunction with your duties as an armor vehicle crewman?

0 Yes/**162** 0 No/**81**

15. Do you wear a PASGT helmet whenever you get out of the vehicle?

0 All the Time/**79**
0 Most of the Time/**91**
0 Sometimes/**45**
0 Hardly Ever/**14**
0 Never/**12**

16. How often do you wear the CVC DH-132 during field training?

0 2-4 Hours a Day/**36**
0 4-6 Hours a Day/**52**
0 6-8 Hours a Day/**61**
0 8-12 Hours a Day/**54**
0 12-18 Hours a Day/**30**
0 18 to 24 Hours a Day/**1**

The average is 6 hours a day.

17. Do you normally use the chin strap on the CVC DH-132?

0 All the Time/**37**
0 Most of the Time/**50**
0 Sometimes/**51**
0 Hardly Ever/**41**
0 Never/**66**

18. How tight do you wear the chin strap on the CVC?

0 As tight as possible./**17**
0 Just enough so to seal over the ear cups./**108**
0 So the strap touches my chin./**20**
0 Don't tighten it at all./**7**
0 Just let it hang loose so it looks like you have it on./**5**
0 Never wear it fastened./**76**

Note. The not wearing of chin straps is a leadership problem in the units. Soldiers are required to fasten the chin strap when wearing the helmet, but if they get away with not using it, they do.

19. Do you wear ear plugs when wearing the CVC DH-132?

0 Most of the time./**0**
0 Sometimes./**20**
0 Only during live fires./**20**
0 Hardly ever./**14**
0 Never./**166**

20. Have you experienced a facial accident in an armored vehicle that may have been prevented by a facial shield?

0 Yes/**60** 0 No/**184**

21. Do you think facial protection is necessary for the CVC DH-132?

0 All the Time/**60**
0 Most of the Time/**47**
0 Sometimes/**100**
0 Hardly Ever/**19**
0 Never/**19**

22. Should facial protection be removable from or permanent on the CVC DH-132?

0 Removable/**204** 0 Permanent/**31**

23. If the CVC DH-132 had removable facial protection of some sort, you would use it . . .?

0 All the Time/**58**
0 Most of the Time/**91**
0 Sometimes/**71**
0 Hardly Ever/**16**
0 Never/**8**

24. Which is the most important for the CVC DH-132 to have?

0 Ballistic protection /**20**
0 Just bump protection/**50**
0 Both are equally important/**171**

25. Would you prefer the CVC DH-132 to be lighter weight?

0 Yes/**124** 0 No/**45** 0 Don't care/**73**

26. How do you rate the comfort of the CVC DH-132?

0 Very Comfortable/**2**
0 Comfortable/**62**
0 Neither Comfortable or Uncomfortable/**87**
0 Uncomfortable/**78**
0 Very Uncomfortable/**16**

27. In warm weather, do you feel the CVC is uncomfortably hot to wear?

0 Yes/**187** 0 No/**53**

28. Do you use the CVC DH-132 for command and control?

0 All the Time/**88**
0 Most of the Time/**86**
0 Sometimes/**41**
0 Hardly Ever/**12**
0 Never/**17**

29. How comfortable are the ear cups on the CVC DH-132?

0 Very Comfortable/**4**
0 Comfortable/**79**
0 Neither Comfortable or Uncomfortable/**66**
0 Uncomfortable/**78**
0 Very Uncomfortable/**15**

30. Would you like to see a more adjustable head harness for the CVC DH-132?

0 Yes/**207** 0 No/**7** 0 Don't care/**24**

31. Would you like to see a more comfortable helmet?

0 Yes/**229** 0 No/**0** 0 Don't care/**11**

32. Would you like to have more adjustments on the helmet (i.e., adjustments at the ear cups, chin strap, head harness, neck support)?

0 Yes/**215** 0 No/**10** 0 Don't care, the current version is fine./**15**

33. Did you participate in Operation Desert Storm as an armored vehicle crewman who wore the CVC (if Yes to Question 33, answer 34 - 35; if No, skip to Question 36)?

0 Yes/**119** 0 No /**120**

34. Did you feel the current CVC provided you the protection you needed in combat?

0 All the Time/**14**
0 Most of the Time/**24**
0 Sometimes/**34**
0 Hardly Ever/**20**
0 Never/**28**

35. Did you ever wear your Kevlar PASGT helmet?

0 Whenever I dismounted the vehicle./**86**
0 Sometimes/**21**
0 Hardly Ever/**4**
0 Never/**10**

Answers to Subjective Questions. ( ) at end of each answer is the number of soldiers who answered the same or similar. If no ( ) then only one soldier made the comment.

36. Do you have any comments about your experience with the CVC either during Desert Storm or your recent rotation here at National Training Center?

The helmet gets uncomfortable after wearing it for a while, too tight. (31)

The spaghetti cord gets in the way during operations in all the crew positions (16) (One reason is the location of the control boxes plus the cord becomes disconnected at times due to movement in the vehicle.)

Can't talk to anyone when getting out of the vehicle. (9) (When you have to dismount the vehicle, for ground guiding, maintenance, security, or to quickly talk to someone, you still need to maintain communication with crew and other elements. You can't do that with the current communicator system.)

CVC is very hot and uncomfortable in warm weather. (26)

The ear pads are very uncomfortable. (17)

Sometimes hard to hear the radio over the engine noise. (13)

Boom microphone wires get loose often and get caught on something. (12)

Spaghetti cords become disconnected easily. (11)

Communication problems or difficult to maintain. (9)

The CVC helmet was very hard to keep assembled, ear cups always falling off or out. (5)

Communication wires from CVC to "spaghetti cord" work only 50% of the time. (3)

Vehicle commanders need some type of attachment to protect them from the elements. (3)

I am relatively satisfied with it. (3)

Didn't feel safe wearing the CVC. (4)

The DH-132 is outdated. (2)

When I sweat, the ear cups collect water. (7)

Spaghetti cords get heavy. (4)

Communicator cord breaking at the earpiece. (2)

Too much static over the communication system. (4)

When water or sand gets into the microphone, communication is difficult. (4)

While driving the vehicle at night, hitting ruts, ran into holes, and slammed a face into the hatch. (5)

Can't find a CVC that fits; have to take the one that's in the vehicle. (3)

Goggles hard to get sealed. (5)

Too heavy. (3)

The goggles scratch too easily. (4)

Replacement parts were hard to get, and cleaning was a problem during ODS. (5)

Crashing into the vehicle in front during convoy operations at night, in the fog. (2)

Artillery crewmen, the communicator cord is not long enough to work inside the vehicle with the helmet on all the time.

Spend a lot of time adjusting the helmet for comfort while driving down the tank trail.

Had to wear the helmet for 22 hours straight during road march in Desert Storm; got real uncomfortable.

It wasn't much of a war, but still, I wasn't completely at ease as far as ballistic capability, and it got pretty unbearable during extremely hot weather.

Yes, my M3 Bradley was shot by an M1 with a 120mm gun during Desert Storm; I was wearing my CVC at the time and suffered only burns to the face. I was thrown out of the burning vehicle, and the fall was easier because of the protection of the CVC shell

37. Do you ever wear anything under your CVC DH-132, what are they (i.e., Ski Mask, Balaclava)?

I wear a NOMEX Balaclava. (40) (Makes the helmet fit too tight.)

Ski cap or mask. (33)

Scarf for dust. (27)

Not very often; any time you wear anything under the helmet, it gets too uncomfortable. (16)

Hard to hear when wearing anything under the helmet. (15)

Cold weather or pile cap. (14)

Goggles, sun, wind, dust. (13)

Cold weather face mask. (12)

Sleeping cap hood for warmth. (9)

Balaclava or bandana around neck and mouth. (8)

Glasses or sunglasses. (6)

I wear ski masks and the balaclava, but because the CVC is not adjustable, it makes it uncomfortable to wear. (4)

A rag around my head in the summer time. (6)

BDU cap. (6)

NVG harness. (3)

Wear nothing. (8)

A towel around my head to add cushion and collect sweat. (2)

No, I already get headaches from wearing the helmet for so long.

Protective mask, gets too hot under the helmet.

Helmet fits too tight to wear anything under it.

Headphones from a walkman!

Wool scarf.

Protective Mask. (Everyone)

38. If you are someone who uses sighting devices (i.e., ISU, periscopes, VVS, brow pads), does the current helmet get in the way of using any of them?

Having to tilt the CVC back to use the sights or brow pad. (24) (When this happens, the helmet digs in the back of the neck and the ear cups become uncomfortable).

Sometimes, it's hard to use sights required; the helmet rests on sights or brow pads and presents problems when wearing the helmet. (22)

Using night vision goggles is difficult. (12) (Have to hold in one hand.)

When driving with the night vision goggles, the harness is strapped over your head and the CVC doesn't fit right or is falling off all the time. (8)

Helmet rests on the brow pad. (7)

Loss of peripheral vision. (3)

Because of the adjustment when using the VVS, the helmet will move and become uncomfortable. (2)

Using night driving scope on M113 series vehicles means you have to place the microphone below your chin to see through the scope; communication is difficult.

Wearing glasses and using the sights is difficult; pressure to my head. (3)

The boom microphone gets in the way of the gunner's sight. (2)

The spaghetti cord gets knotted.

Only when used with the protective mask is it difficult.

The ground positioning system on the M1A1 is in such a way that sometimes you can't use it while wearing the CVC. (4)

Tankers need a smaller helmet; it makes using the sighting devices easier to use; head room is limited. (2)

When looking through some of the periscopes, I sometimes take the shell off.

Sometimes, the boom microphone gets in the way of the sight unit.

Goggles and MILES keep falling off when using the sights.

39. If you are in a position that must use fire control devices (i.e., weapon control box, turret control box) would facial protection get in the way of your viewing these panels or devices?

Facial protection would or might get in the way. (36)

Make it impossible to observe through sights on M1. (3)

It would be OK if it were removable or slid back. (9)

Could not see the control box or panel by glancing down; would have to take my eyes off the target. (9)

Not if the facial protection were see-through. (6)

Should be removable. (6)

Around the eyes, it would get in the way. (3)

Would not be able to look through the sight with a face shield on. (8)

A face shield would make more difficult to fit the face into the correct alignment to use the sight. (16)

Only if the facial protection won't fog up the sights.

At the gunner's station on the M728 CEV, you cannot get a good sight picture through the M105 and M32C sights, because the forehead rest and the brim of the CVC interfere with each other.

I don't think it would.

Facial protection probably not a problem in an artillery vehicle. (3)

In the FISTV, would take the CVC off to use the sights to get accurate picture.

Facial protection should not make the helmet any hotter than it is.

Facial protection is needed to block wind, sand, dust, and prevent injuries. The tank commander (maybe the loader), need facial protection the most; a shield must be able to flip up to allow the tank commander to look at sights.

Facial protection needed for the tank commander (TC) of multiple launch rocket system who exposes himself outside the hatch when driving.

Goggles sometimes get in the way.

40. Could you make any suggestions to improve the CVC DH-132?

COMFORT AND FIT

Make the helmet more comfortable. (37)

Have a built-in clear and sun shield for the eyes like the flight helmet, with possible seal device around edges. (35)

Make the helmet cooler, more air circulation or ventilation. (31)

Make it lighter; it's heavy enough. (36)

Make the CVC more adjustable. (24)

Make the padding inside the helmet better. (22)

One size fits all. The CVCs now are assigned to the unit, not the crew. It's hard to find the right size to fit.

You never know which CVC you will get from day to day, need to issue the helmet to an individual, not to the vehicle.

Why do you need more protection on the helmet; you have the vehicle around you?

More size options. (12)

Use one size fits all. By using an air-up system or form fitting. This would allow for a better fit and a more comfortable wear. (8)

Need some sort of neck support or protection. (7)

CVC is more comfortable than the Kevlar, so I wear the CVC more often outside the vehicle.

Would be nice if it could be used as a dismount helmet also.

Need a thicker stronger shell. (6)

More ballistic or head protection. (17)

Ballistic protection needed for Bradley, tank, or vehicle commanders only.

Ballistic protection to the ears. (3)

Helmet could get heavier if comfort were increased. (3)

Don't make the helmet wider. (2) (M1 crewman)

Shell needs to be similar to Navy flight deck helmet, multiple hard shell pieces for flexibility.

Remove the bumps on the rubber padding. (4)

Could you use the NBC ventilation system in the M1A1 to ventilate the CVC also? Small hoses that connect into the helmet.

Air vents for the top of the head. (4)

Air holes for the head. (4)

More cushion on the ear cups. (19)

Ear cup pads keep falling off. (8)

Ear cups more adjustable. (12)

More room for the ears. (3)

Make the padding one solid piece.

Jell pads for cushion.

Sweat band.

Better chin strap.

Form fit chin pad or cup. (8)

Use velcro on chin strap; get rid of the snap. (2)

More durable. (Since the helmet stays with the vehicle, there is less care taken overall by the crew members, versus if the CVC were issued to an individual.)

FACIAL PROTECTION

Facial protection is a good idea. (31)

Facial protection is not needed for gunners. (9)

Not needed all the time. (3)

Incorporate a dust mask with the facial protection. (6)

See-through facial protection. (9) (Football style helmet)

Make a jaw guard, like a motorcycle helmet or NASCAR driver. (3)

Flip-up or removable. (6)

Make sure facial protection can incorporate the protective mask M25.

COMMUNICATIONS

Wireless or cordless communication system. (43) (Makes it easier for "outside the vehicle tasks," ground guiding, reloading operations, maintaining the vehicle while still listening to the radio, dismounting the TC to do short reconnaissance.)

When working with the M9 ACE, hands are busy at the controls and the vehicle is very loud. Soldiers must work with their heads outside the vehicle; if someone starts talking on the radio, the soldier must stop the vehicle to listen.

Weatherproofing, especially the communicator.(5)

Put microphone in the facial protection. (2)

Need a smaller/better boom microphone. (11) (throat mic?)

Better communication system. (18) (More reliable)

Better wire connection, to prevent cords becoming separated. (9)

Better electrical wiring to prevent shorts in communication between commander and crew. (4)

I don't like the fact that I have to un-key my microphone when the TC needs to call out. (2)

The cord connections with the helmet come apart too easily.

Make the quick disconnection at the control box.

Relocate the switch on the ear cup; it gets bumped and sometime keys the system unnoticed. (2)

The vibrations in the driver's position make it difficult to hear properly. (2)

Need to be able to hear better; vehicle noise sometimes drowns out the voice communication. (9)

A switch to block out radio noise, be able to just hear inter-vehicle commands, at the driver station.

Ear plug type speakers for the ears.

OTHER CONCERNS

The goggles don't fit tight to your head. (5)

Design new sand, wind, dust goggles that fit on the helmet or attach to the helmet. (5)

Attachment for the PVS-7B's right on the helmet.(11) (All types of NVGs)

Make it easier to clean and maintain. (8)

Consider female soldiers.

Consider soldiers who wear glasses. CVC is uncomfortable while wearing glasses, especially around the ear cups. (9)

Incorporate a Nomex hood or fire protection in the helmet.

User-issued helmets and more operator level maintenance. Some type of modular replacement part system.

Some way to incorporate the MILES head harness.

41. If you have ever had a head injury of any type or severity (including the face), briefly explain.

Cut chin or face while driving in rough terrain. (13)

Headaches from wearing the helmet too long. (10)

Ears get sore with prolonged use. (4)

Hit eyes or chin on the sights during sudden stops. (4)

Once wrecked an AVLB (M48) while towing another. In the collision, I hit my jaw into the hatch and cracked my CVC cover on the backlash.

Just bugs, dust, rain, hail, rocks, tree branches, and snow hitting the face while driving. (8)

The goggles don't seal, get sand in my face.

Accelerator stuck on a Bradley and it ran into a ditch. Driver suffered a frontal super orbialal fracture and fractured sinus.

Hit periscopes inside driver's hatch after landing hard.

Thrown into the hatch hole several times while driving in the dark. Face took the brunt of the blow.

Minor bumps to the head. (5)

Bumped head hard on the brow pad.

Bumped nose inside the vehicle. (5)

Bottomed out the vehicle going down hill, hit face on the front of the driver's hatch. (2)

Hit a ditch, face bumped the hatch at the boom microphone. Only minor injury, but if vehicle had been going faster, would have lost some teeth.

Hit my lip several times when making quick stops. (3)

Driving around at night, got bumped on the head; the hatch latch poked through at the ear cup.

50-cal. mount swung around and hit face. (4) (Some broke their nose)

Broken teeth after hitting edge of vehicle or 50-cal. mount. (4)

Hit face on MG mount.

Scratched eye because of branches.

Broke jaw when the vehicle hit a ditch.

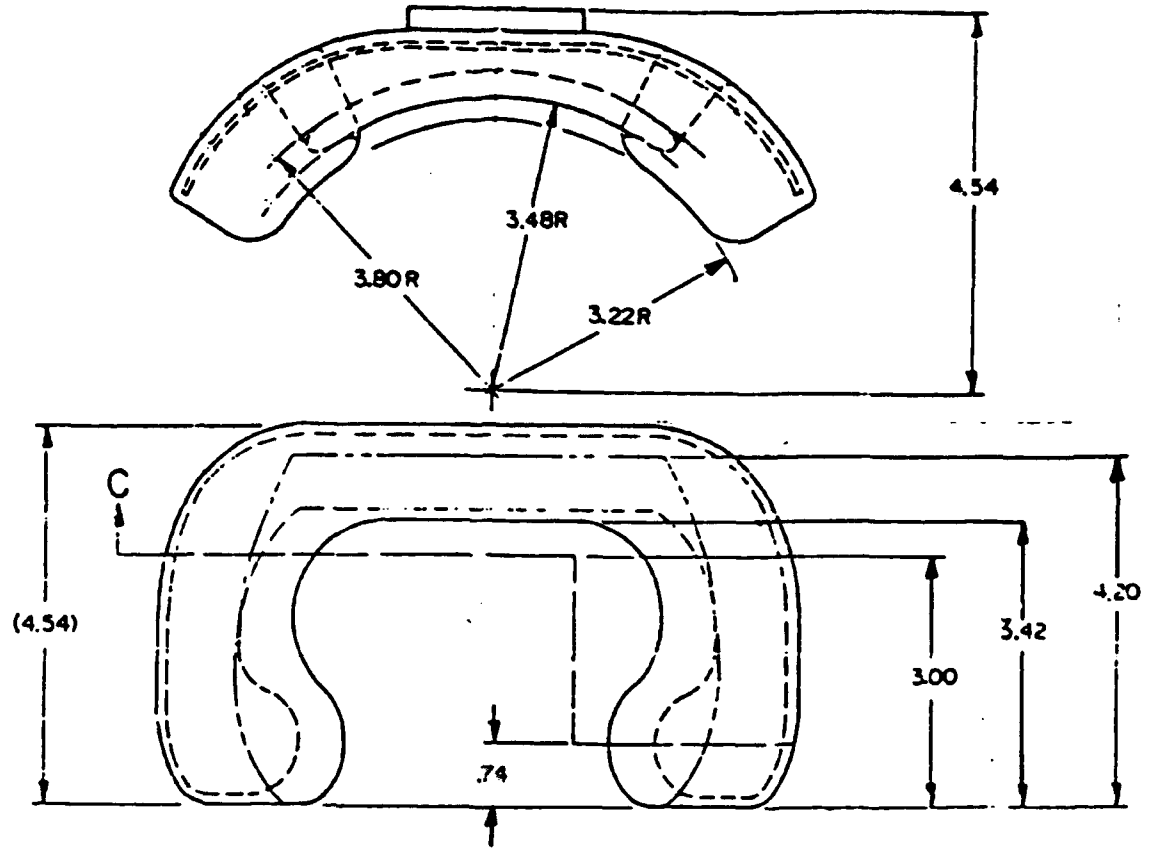
I would rather suffer with the same little problems, than get my tank killed because some face protector prevents my gunner or me (TC) from getting a good, quick sight picture of the enemy (comment from a Desert Storm veteran)

Driving at night, I hit my nose on the night sight (VVS-2), causing a bloody nose.

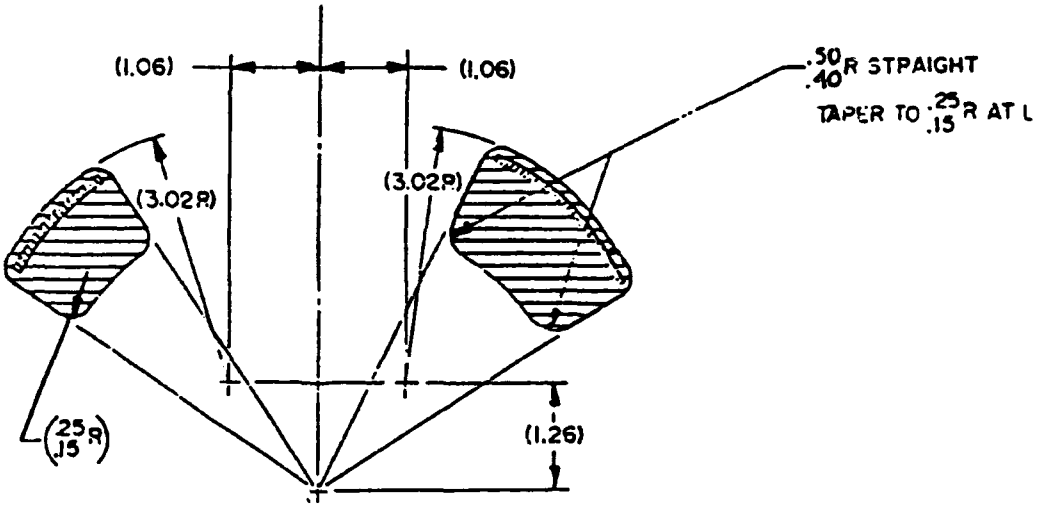
With a lot of luck, I haven't had any serious injuries.

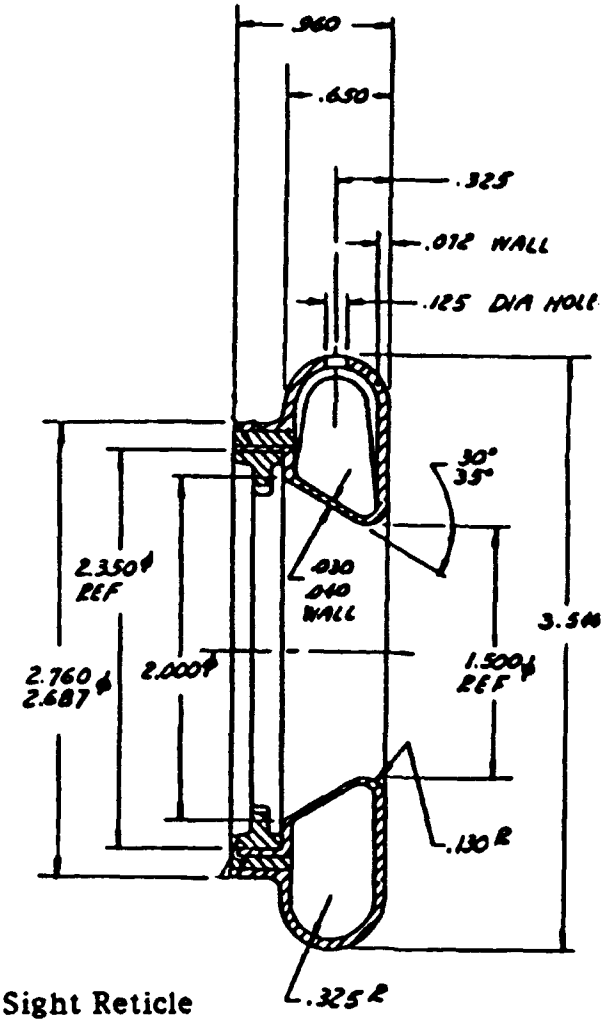
APPENDIX B

DRAWINGS OF CURRENT SIGHTING SYSTEMS

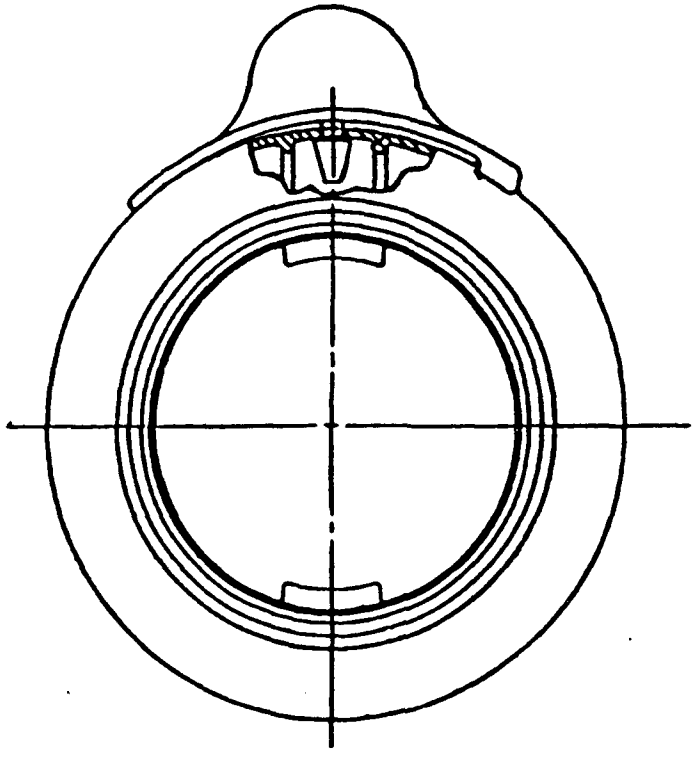


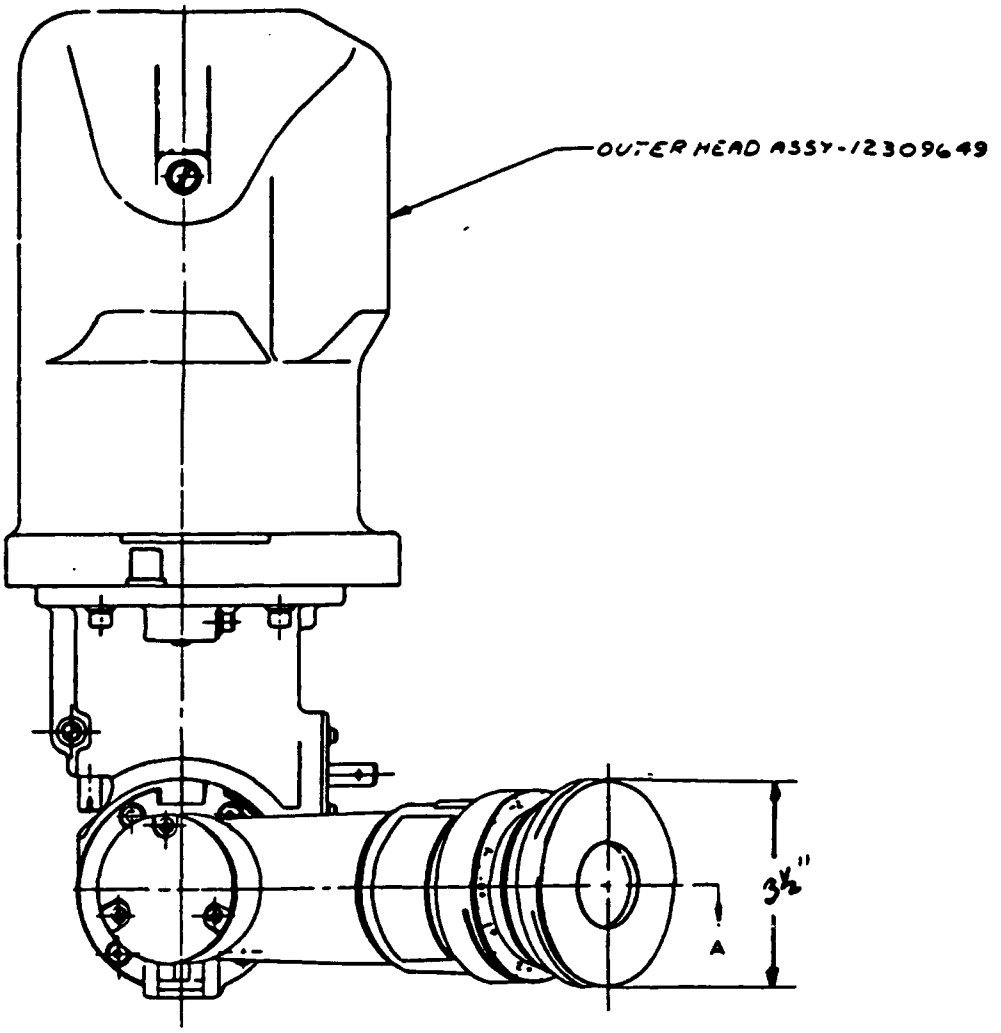
Brow Pads for Gunners and Commanders in M1 and M2/M3 Armor Vehicle



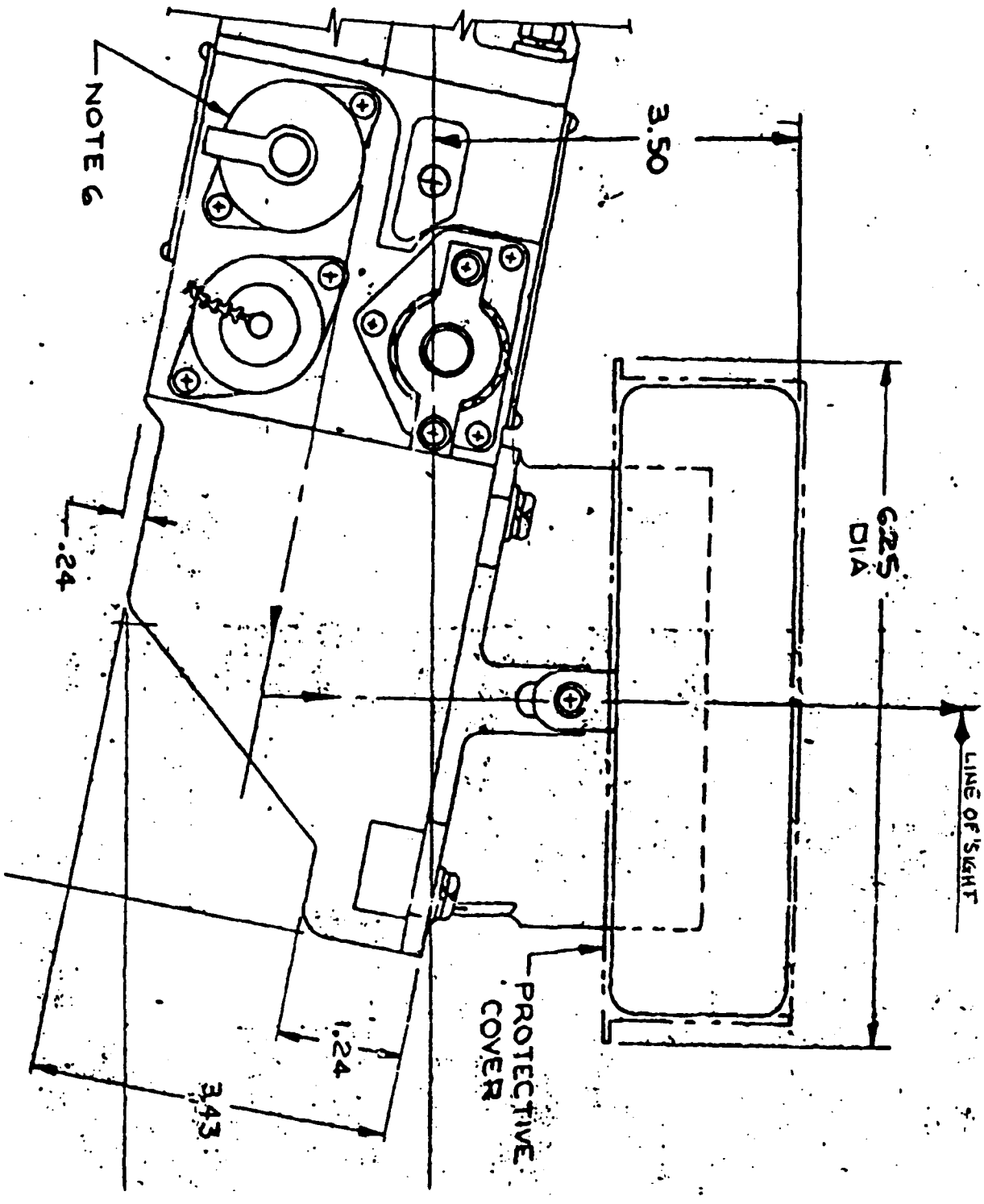


Eye Cup for Sight Reticle





Auxiliary Sight Unit, with Reticle



Driver's Night Vision Periscope for M2

APPENDIX C

AVAILABLE STEADY STATE AND IMPULSE NOISE DATA FROM VARIOUS CREW STATIONS

AVAILABLE STEADY STATE AND IMPULSE NOISE
DATA FROM VARIOUS CREW STATIONS

ACOUSTICAL TEST DATA

TIME:	DATE:	TEST ITEM:
1000	15 NOV 1988	BFVS/M2A2 500HP

TEST CONDUCTED BY:	TEST ITEM OPERATOR:	REG./MODEL NO:
M. CARLSON	MR. KESTLER	

SERIAL NO.	ODOMETER:	HOUR METER:	TEST ITEM CONDITION:
P004	1811	N/A	TILES INSTALLED

TEMPERATURE:	HUMIDITY:	TEST SITE:	SURFACE:
53 DEG F	74%	PERRYMAN	PAVED

TERRAIN:	BAROMETERIC PRESSURE:	SKY COVER:	WIND DIRECTION:
FLAT	1027.2	SCATTERED	NE

WIND SPEED:	TAPE RECORDER:	OCTAVE ANALYZER:	SOUND LEVEL METER:
4 KNOTS	RACAL 7 CH	B&K 2131	

MICROPHONE:	STATIONARY OPERATION	HIGHWAY DRIVING	DRIVE-BY
4155	( )	(X)	( )

INTERIOR	EXTERIOR	MICROPHONE LOCATION:
(X)	( )	DRIVER'S POSITION

****

							OCTAVE BAND CENTER FREQUENCIES (HZ)							
GEAR	RPM	SPEED KM/HR	dBA	dBB	dBC	ALL PASS	31.5	63	125	250	500	1000	2000	4000	8000
						HATCHES OPEN									
N		IDLE	83	90	98	99	92	97	84	80	80	78	76	65	60
D		16	102*	108	112	113	105	110	104	105*	101	93	89	79	76
D		32	108*	117	125	125	110	125*	109	109*	108*	99	96	88	83
D		48	110*	116	119	120	110	116	113*	113*	109*	104*	100	91	84
D		61	113*	119	122	122	114	116	117*	116*	113*	106*	102*	94	85
						HATCHES CLOSED									
N		IDLE	83	91	100	103	102	92	90	81	78	79	76	67	63
D		16	106*	113	118	120	117	108	112*	110*	105*	98	91	81	76
D		32	113*	121	127	127	112	126*	116*	115*	113*	104*	100	93	90
D		48	115*	121	125	126	114	122*	119*	118*	114*	108*	104*	91	86
D		61	117*	123	126	126	115	113	124*	118*	115*	111*	106*	95	89
						MAXIMUM ALLOWABLE LIMITS OF MIL-STD-1474B(MI), TABLE 2, CATEGORY B									
			100				121	111	103	102	100	100	100	100	

*LEVELS EXCEEDING MAXIMUM ALLOWABLE LIMITS OF CATEGORY B

ACOUSTICAL TEST DATA

TIME:	DATE:	TEST ITEM:
1000	15 NOV 1988	BFVS/M2A2 500HP

TEST CONDUCTED BY:	TEST ITEM OPERATOR:	REG./MODEL NO:
M. CARLSON	MR. KESTLER	

SERIAL NO.	ODOMETER:	HOUR METER:	TEST ITEM CONDITION:
P004	1811	N/A	TILES INSTALLED

TEMPERATURE:	HUMIDITY:	TEST SITE:	SURFACE:
53 DEG F	74%	PERRYMAN	PAVED

TERRAIN:	BAROMETERIC PRESSURE:	SKY COVER:	WIND DIRECTION:
FLAT	1027.2	SCATTERED	NE

WIND SPEED:	TAPE RECORDER:	OCTAVE ANALYZER:	SOUND LEVEL METER:
4 KNOTS	RACAL 7 CH	B&K 2131	

MICROPHONE:	STATIONARY OPERATION	HIGHWAY DRIVING	DRIVE-BY
4155	( )	(X)	( )

INTERIOR	EXTERIOR	MICROPHONE LOCATION:
(X)	( )	GUNNER'S POSITION

****

						OCTAVE BAND CENTER FREQUENCIES (HZ)								
GEAR	RPM	SPEED KM/HR	dBA	dBB	dBC	ALL PASS	31.5	63	125	250	500	1000	2000	4000	8000
HATCHES OPEN															
N		IDLE	78	92	100	101	81	100	84	73	71	72	68	59	58
D		16	98	106	112	113	107	109	107	101	94	92	88	80	74
D		32	105*	117	125	125	102	125*	110	103	101	98	96	89	84
D		48	107*	114	119	120	106	117	114*	109*	103*	100	99	89	83
D		61	105*	115	120	120	105	112	119*	111*	105*	102*	100	94	84
HATCHES CLOSED															
N		IDLE	80	92	98	99	89	97	93	75	72	72	69	60	58
D		16	101*	110	115	116	110	113	110	105*	95	95	89	82	75
D		32	107*	116	122	123	108	122*	116*	107*	102	100	98	92	88
D		48	109*	118	124	125	113	123*	118*	113*	103*	103*	100	92	86
D		61	115*	125	129	130	112	116	129*	113*	105*	103*	101*	93	87
MAXIMUM ALLOWABLE LIMITS OF MIL-STD-1474B(MI), TABLE 2, CATEGORY B			109					121	111	103	102	100	100	100	100

*LEVELS EXCEEDING MAXIMUM ALLOWABLE LIMITS OF CATEGORY B

ACOUSTICAL TEST DATA

TIME:	DATE:	TEST ITEM:
1000	15 NOV 1988	BFVS/M2A2 500HP

TEST CONDUCTED BY:	TEST ITEM OPERATOR:	REG./MODEL NO:
M. CARLSON	MR. KESTLER	

SERIAL NO.	ODOMETER:	HOUR METER:	TEST ITEM CONDITION:
P004	1811	N/A	TILES INSTALLED

TEMPERATURE:	HUMIDITY:	TEST SITE:	SURFACE:
53 DEG F	74%	PERRYMAN	PAVED

TERRAIN:	BAROMETERIC PRESSURE:	SKY COVER:	WIND DIRECTION:
FLAT	1027.2	SCATTERED	NE

WIND SPEED:	TAPE RECORDER:	OCTAVE ANALYZER:	SOUND LEVEL METER:
4 KNOTS	RACAL 7 CH	B&K 2131	

MICROPHONE:	STATIONARY OPERATION	HIGHWAY DRIVING	DRIVE-BY
4155	( )	(X)	( )

INTERIOR	EXTERIOR	MICROPHONE LOCATION:
(X)	( )	CMDR'S POSITION

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						OCTAVE BAND CENTER FREQUENCIES (HZ)									
GEAR	RPM	SPEED KM/HR	dBA	dBB	dBC	ALL PASS	31.5	63	125	250	500	1000	2000	4000	8000
HATCHES OPEN															
N		IDLE	80	93	102	102	81	102	79	78	74	73	69	61	59
D		16	99	106	112	114	109	111	102	103	97	93	88	82	76
D		32	107*	118	126	127	104	127*	106	107*	104*	99	96	91	86
D		48	109*	115	119	120	108	117	111	113*	106*	103*	100	91	84
D		61	110*	117	120	120	107	114	116*	115*	107*	102*	101*	96	86
HATCHES CLOSED															
N		IDLE	79	90	98	99	89	98	87	77	74	72	69	62	59
D		16	100	107	114	115	110	112	103	104*	98	95	88	82	75
D		32	107*	114	121	122	108	122*	107	107*	105*	101*	97	93	86
D		48	109*	116	122	123	114	121	114*	112*	106*	101*	100	91	84
D		61	111*	120	124	124	112	116	123*	113*	108*	102*	101*	95	87
MAXIMUM ALLOWABLE LIMITS OF MIL-STD-1474B(MI), TABLE 2, CATEGORY B															
			100				121	111	103	102	100	100	100	100	
LEVELS EXCEEDING MAXIMUM ALLOWABLE LIMITS OF CATEGORY B															

ACOUSTICAL TEST DATA

TIME:	DATE:	TEST ITEM:
1000	15 NOV 1988	BFVS/M2A2 500HP

TEST CONDUCTED BY:	TEST ITEM OPERATOR:	REG./MODEL NO:
M. CARLSON	MR. KESTLER	

SERIAL NO.	ODOMETER:	HOUR METER:	TEST ITEM CONDITION:
P004	1811	N/A	TILES INSTALLED

TEMPERATURE:	HUMIDITY:	TEST SITE:	SURFACE:
53 DEG F	74%	PERRYMAN	PAVED

TERRAIN:	BAROMETERIC PRESSURE:	SKY COVER:	WIND DIRECTION:
FLAT	1027.2	SCATTERED	NE

WIND SPEED:	TAPE RECORDER:	OCTAVE ANALYZER:	SOUND LEVEL METER:
4 KNOTS	RACAL 7 CH	B&K 2131	

MICROPHONE:	STATIONARY OPERATION	HIGHWAY DRIVING	DRIVE-BY
4155	( )	(X)	( )

INTERIOR	EXTERIOR	MICROPHONE LOCATION:
(X)	( )	RIGHT FRONT CREW POSITON

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						OCTAVE BAND CENTER FREQUENCIES (HZ)									
GEAR	RPM	SPEED KM/HR	dBA	dBB	dBC	ALL PASS	31.5	63	125	250	500	1000	2000	4000	8000
HATCHES OPEN															
N		IDLE	77	87	94	95	89	94	85	76	73	70	67	59	55
D		16	105*	111	116	118	115	110	108	110*	102	97	94	90	87
D		32	110*	116	123	123	109	122*	112*	111*	107*	102*	101*	98	94
D		48	114*	120	123	124	110	120	116*	118*	111*	106*	105*	100	96
D		61	115*	120	122	123	111	113	117*	119*	113*	107*	106*	102*	97
HATCHES CLOSED															
N		IDLE	76	86	94	95	92	91	84	76	73	69	67	59	55
D		16	105*	111	115	116	110	109	108	109*	102	97	94	91	86
D		32	111*	120	128	128	107	128*	113*	113*	109*	103*	102*	99	96
D		48	115*	120	124	124	107	121	117*	118*	112*	107*	105*	101*	97
D		61	115*	120	122	122	108	113	116*	119*	113*	107*	105*	102*	97
			MAXIMUM ALLOWABLE LIMITS OF MIL-STD-1474B(MI), TABLE 2, CATEGORY B												
			100					121	111	103	102	100	100	100	100

*LEVELS EXCEEDING MAXIMUM ALLOWABLE LIMITS OF CATEGORY B

ACOUSTICAL TEST DATA

TIME: 1000	DATE: 15 NOV 1988	TEST ITEM: BFVS/M2A2 500HP
TEST CONDUCTED BY: M. CARLSON	TEST ITEM OPERATOR: MR. KESTLER	REG./MODEL NO:
SERIAL NO. P004	ODOMETER: 1811	HOUR METER: N/A
TEST ITEM CONDITION: TILES INSTALLED		
TEMPERATURE: 53 DEG F	HUMIDITY: 74%	TEST SITE: PERRYMAN
SURFACE: PAVED		
TERRAIN: FLAT	BAROMETERIC PRESSURE: 1027.2	SKY COVER: SCATTERED
WIND DIRECTION: NE		
WIND SPEED: 4 KNOTS	TAPE RECORDER: RACAL 7 CH	OCTAVE ANALYZER: B&K 2131
SOUND LEVEL METER:		
MICROPHONE: 4155	STATIONARY OPERATION ( ) HIGHWAY DRIVING (X) DRIVE-BY ( )	
INTERIOR (X) EXTERIOR ( )	MICROPHONE LOCATION: LEFT REAR CREW POSITION	

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						OCTAVE BAND CENTER FREQUENCIES (HZ)								
GEAR	RPM	SPEED KM/HR	dBA	dBB	dBC	ALL PASS	31.5	63	125	250	500	1000	2000	4000	8000
HATCHES OPEN															
N		IDLE	80	90	98	99	91	98	84	76	76	74	70	68	68
D		16	106*	112	117	118	115	111	109	110*	104*	98	96	92	89
D		32	110*	117	123	123	110	122*	112*	111*	109*	102*	101*	97	93
D		48	115*	121	125	125	110	123*	118*	118*	114*	108*	106*	101*	96
D		61	117*	122	125	126	112	116	123*	119*	115*	108*	107*	102*	98
HATCHES CLOSED															
N		IDLE	79	85	93	96	94	87	85	76	76	73	70	68	68
D		16	106*	112	116	117	111	112	110	109*	104*	99	97	92	87
D		32	111*	118	123	124	108	123*	113*	113*	110*	103*	102*	98	94
D		48	117*	122	126	127	110	124*	120*	118*	115*	109*	107*	103*	98
D		61	117*	123	126	126	110	114	124*	118*	115*	108*	106*	102*	97
						MAXIMUM ALLOWABLE LIMITS OF MIL-STD-1474B(MI), TABLE 2, CATEGORY B									
			100				121	111	103	102	100	100	100	100	

*LEVELS EXCEEDING MAXIMUM ALLOWABLE LIMITS OF CATEGORY B

FIRING SCENARIO FOR 25-mm M242 CANNON

Test Condition	Hatches				Turret Position (mils)	Cannon Elevation (mils)
	Driver	Commander	Gunner	Cargo		
1	closed	closed	closed	closed	0	0
2	closed	closed	closed	closed	0	500
3	closed	closed	closed	closed	0	990
4	full open	full open	full open	straight up	4980	0
5	full open	full open	full open	straight up	4980	500
6	full open	full open	full open	straight up	4980	990
7	popped	full open	full open	popped	4980	0
8	popped	full open	full open	popped	4980	500
9	popped	full open	full open	popped	4980	990
10	full open	full open	full open	straight up	4290	0
11	full open	full open	full open	straight up	4390	500
12	full open	full open	full open	straight up	4390	990
13	popped	full open	full open	popped	4390	0
14	popped	full open	full open	popped	4390	500
15	popped	full open	full open	popped	4390	990
16	full open	full open	full open	straight up	2110	0
17	full open	full open	full open	straight up	2110	500
18	full open	full open	full open	straight up	2110	990
19	popped	full open	full open	popped	2110	0
20	popped	full open	full open	popped	2110	500
21	popped	full open	full open	popped	2110	990
22	full open	full open	full open	straight up	20	0
23	full open	full open	full open	straight up	20	300
24	full open	full open	full open	straight up	20	500
25	full open	full open	full open	straight up	20	990
26	popped	full open	full open	popped	20	0
27	popped	full open	full open	popped	20	300
28	popped	full open	full open	popped	20	500
29	popped	full open	full open	popped	20	990

PEAK SOUND PRESSURE LEVELS AND EXPOSURE LIMITS (M3A1)

Position	Round	Peak (dB)	Duration "A" (msec)	Duration "B" (msec)	Test Condition	Maximum Allowable Exposures per Day Single	Maximum Allowable Exposures per Day Double
Driver	1	145	6.98	170.94	1	> 1000	> 1000
	2	145	8.62	172.34	1	> 1000	> 1000
	3	145	6.66	171.68	1	> 1000	> 1000
Gunner	1	146	3.94	181.56	1	> 1000	> 1000
	2	145	4.68	181.26	1	> 1000	> 1000
	3	144	3.40	181.02	1	> 1000	> 1000
Left Rear	1	140	6.40	182.32	1	> 1000	> 1000
	2	139	5.50	182.76	1	> 1000	> 1000
	3	138	5.80	>200.00	1	> 1000	> 1000
Right Rear	1	141	5.70	152.76	1	> 1000	> 1000
	2	141	8.26	153.24	1	> 1000	> 1000
	3	140	6.12	154.32	1	> 1000	> 1000
Driver	1	144	1.36	195.94	2	> 1000	> 1000
	2	144	9.64	>200.00	2	> 1000	> 1000
	3	144	2.26	>200.00	2	> 1000	> 1000
Gunner	1	146	2.00	170.30	2	> 1000	> 1000
	2	146	1.98	170.66	2	> 1000	> 1000
	3	146	1.96	170.58	2	> 1000	> 1000
Left Rear	1	136	5.82	>200.00	2	> 1000	> 1000
	2	135	9.12	>200.00	2	> 1000	> 1000
	3	136	7.62	>200.00	2	> 1000	> 1000
Right Rear	1	140	1.34	168.30	2	> 1000	> 1000
	2	140	2.26	177.62	2	> 1000	> 1000
	3	139	2.20	169.04	2	> 1000	> 1000
Driver	1	142	7.88	>200.00	3	> 1000	> 1000
	2	143	8.64	>200.00	3	> 1000	> 1000
	3	142	8.06	188.22	3	> 1000	> 1000
Gunner	1	143	8.20	176.22	3	> 1000	> 1000
	2	143	8.24	176.54	3	> 1000	> 1000
	3	143	9.10	176.38	3	> 1000	> 1000
Left Rear	1	136	3.64	>200.00	3	> 1000	> 1000
	2	137	6.68	>200.00	3	> 1000	> 1000
	3	138	3.92	>200.00	3	> 1000	> 1000
Right Rear	1	135	10.02	>200.00	3	> 1000	> 1000
	2	138	7.50	176.28	3	> 1000	> 1000
	3	135	17.50	>200.00	3	> 1000	> 1000

PEAK SOUND PRESSURE LEVELS AND EXPOSURE LIMITS

Position	Round	Peak (dB)	Duration "A" (msec)	Duration "B" (msec)	Test Condition	Maximum Allowable Exposures per Day: Single	Maximum Allowable Exposures per Day: Double
Driver	1	166	0.94	44.13	4	> 1000	> 1000
	2	166	0.94	44.15	4	> 1000	> 1000
	3	165	0.92	61.27	4	> 1000	> 1000
Gunner	1	159	2.75	65.46	4	> 1000	> 1000
	2	160	2.31	65.30	4	> 1000	> 1000
	3	160	2.31	65.08	4	> 1000	> 1000
Left Rear	1	140	6.98	102.32	4	> 1000	> 1000
	2	140	7.04	102.46	4	> 1000	> 1000
	3	140	7.00	99.88	4	> 1000	> 1000
Right Rear	1	157	1.81	29.58	4	> 1000	> 1000
	2	157	0.50	19.32	4	> 1000	> 1000
	3	166	0.38	7.53	4	> 1000	> 1000
Driver	1	164	1.66	40.43	5	> 1000	> 1000
	2	163	1.81	30.84	5	> 1000	> 1000
	3	166	0.48	16.66	5	> 1000	> 1000
Gunner	1	161	2.18	45.89	5	> 1000	> 1000
	2	161	1.68	45.92	5	> 1000	> 1000
	3	162	1.70	45.83	5	> 1000	> 1000
Left Rear	1	156	1.93	81.12	5	> 1000	> 1000
	2	157	2.43	80.95	5	> 1000	> 1000
	3	157	2.01	81.01	5	> 1000	> 1000
Right Rear	1	163	1.76	29.58	5	> 1000	> 1000
	2	163	0.50	19.32	5	> 1000	> 1000
	3	166	0.44	9.25	5	> 1000	> 1000
Driver	1	162	1.60	30.63	6	> 1000	> 1000
	2	163	1.47	37.73	6	> 1000	> 1000
	3	165	1.56	28.44	6	> 1000	> 1000
Gunner	1	165	1.12	46.06	6	> 1000	> 1000
	2	165	1.54	46.03	6	> 1000	> 1000
	3	165	1.00	46.05	6	> 1000	> 1000
Left Rear	1	152	4.34	99.69	6	> 1000	> 1000
	2	152	4.45	99.56	6	> 1000	> 1000
	3	152	4.35	102.54	6	> 1000	> 1000
Right Rear	1	162	1.60	41.75	6	> 1000	> 1000
	2	162	1.71	39.45	6	> 1000	> 1000
	3	164	1.72	28.48	6	> 1000	> 1000

PEAK SOUND PRESSURE LEVELS AND EXPOSURE LIMITS

Position	Round	Peak (dB)	Duration "A" (msec)	Duration "B" (msec)	Test Condition	Maximum Allowable Exposures per Day Single	Maximum Allowable Exposures per Day Double
Driver	1	163	0.49	24.65	7	> 1000	> 1000
	2	163	0.49	23.74	7	> 1000	> 1000
	3	163	0.47	24.18	7	> 1000	> 1000
Gunner	1	165	2.00	79.41	7	747	> 1000
	2	165	2.34	79.45	7	746	> 1000
	3	166	2.22	78.96	7	655	> 1000
Left Rear	1	149	3.28	118.11	7	> 1000	> 1000
	2	149	2.86	117.27	7	> 1000	> 1000
	3	148	3.08	117.34	7	> 1000	> 1000
Right Rear	1	162	0.55	23.66	7	> 1000	> 1000
	2	163	0.53	41.71	7	> 1000	> 1000
	3	163	0.51	22.33	7	> 1000	> 1000
Driver	1	164	1.64	41.23	8	> 1000	> 1000
	2	164	1.69	41.30	8	> 1000	> 1000
	3	164	1.69	36.11	8	> 1000	> 1000
Gunner	1	168	1.95	44.86	8	504	> 1000
	2	168	2.04	44.83	8	553	> 1000
	3	168	2.15	44.95	8	503	> 1000
Left Rear	1	151	2.00	115.33	8	> 1000	> 1000
	2	151	3.33	115.35	8	> 1000	> 1000
	3	151	3.62	115.50	8	> 1000	> 1000
Right Rear	1	164	1.78	39.32	8	> 1000	> 1000
	2	164	1.72	40.26	8	> 1000	> 1000
	3	164	1.67	40.30	8	> 1000	> 1000
Driver	1	161	1.62	42.85	9	> 1000	> 1000
	2	160	1.62	43.34	9	> 1000	> 1000
	3	161	1.65	43.05	9	> 1000	> 1000
Gunner	1	165	1.02	45.55	9	> 1000	> 1000
	2	165	1.51	45.60	9	> 1000	> 1000
	3	165	0.97	45.49	9	> 1000	> 1000
Left Rear	1	153	2.28	113.26	9	> 1000	> 1000
	2	152	2.89	115.02	9	> 1000	> 1000
	3	152	2.93	113.44	9	> 1000	> 1000
Right Rear	1	160	1.84	43.32	9	> 1000	> 1000
	2	160	1.89	46.52	9	> 1000	> 1000
	3	160	1.70	43.29	9	> 1000	> 1000

PEAK SOUND PRESSURE LEVELS AND EXPOSURE LIMITS

Position	Round	Peak (dB)	Duration "A" (msec)	Duration "B" (msec)	Test Condition	Maximum Allowable Exposures per Day Single	Maximum Allowable Exposures per Day Double
Driver	1	160	2.65	>200.00	10	> 1000	> 1000
	2	160	0.80	>200.00	10	> 1000	> 1000
	3	159	2.29	>200.00	10	> 1000	> 1000
Gunner	1	158	3.72	65.53	10	> 1000	> 1000
	2	157	3.30	46.29	10	> 1000	> 1000
	3	158	3.24	46.29	10	> 1000	> 1000
Left Rear	1	157	0.71	87.48	10	> 1000	> 1000
	2	157	0.69	84.68	10	> 1000	> 1000
	3	157	0.75	85.24	10	> 1000	> 1000
Right Rear	1	166	1.60	25.20	10	> 1000	> 1000
	2	166	1.33	23.50	10	> 1000	> 1000
	3	166	1.09	26.42	10	> 1000	> 1000
Driver	1	159	2.35	>200.00	11	> 1000	> 1000
	2	160	2.55	>200.00	11	> 1000	> 1000
	3	159	2.30	>200.00	11	> 1000	> 1000
Gunner	1	160	2.48	45.75	11	> 1000	> 1000
	2	160	2.43	45.79	11	> 1000	> 1000
	3	160	2.50	45.76	11	> 1000	> 1000
Left Rear	1	158	1.05	62.81	11	> 1000	> 1000
	2	158	1.10	83.23	11	> 1000	> 1000
	3	158	1.03	83.23	11	> 1000	> 1000
Right Rear	1	166	1.50	26.19	11	> 1000	> 1000
	2	166	1.54	26.16	11	> 1000	> 1000
	3	166	1.65	31.85	11	> 1000	> 1000
Driver	1	165	1.10	>200.00	12	316	> 1000
	2	164	1.10	>200.00	12	457	> 1000
	3	162	1.10	>200.00	12	871	> 1000
Gunner	1	164	2.18	63.66	12	> 1000	> 1000
	2	163	2.11	70.00	12	> 1000	> 1000
	3	163	2.31	64.07	12	> 1000	> 1000
Left Rear	1	155	2.29	101.56	12	> 1000	> 1000
	2	155	2.38	101.74	12	> 1000	> 1000
	3	155	2.59	101.84	12	> 1000	> 1000
Right Rear	1	166	1.29	34.90	12	> 1000	> 1000
	2	166	1.27	34.89	12	> 1000	> 1000
	3	166	0.51	24.82	12	> 1000	> 1000

ACOUSTICAL TEST DATA

TIME:	DATE:	TEST ITEM:
1030	20 MAR 1987	M1A1

TEST CONDUCTED BY:	TEST ITEM OPERATOR:	REG./MODEL NO:
P. PATTERSON	B. PARKER	A1

SERIAL NO.	ODOMETER:	HOUR METER:	TEST ITEM CONDITION:
A1	927	114	COMBAT LOADED

TEMPERATURE:	HUMIDITY:	TEST SITE:	SURFACE:
8.8 Deg. C.	36%	PERRYMAN TEST COURSE	ASPHALT

TERRAIN:	BAROMETERIC PRESSURE:	SKY COVER:	WIND DIRECTION:
FLAT	1030.54 mb	CLEAR	N

WIND VELOCITY:	TAPE RECORDER:	OCTAVE ANALYZER:	SCUND LEVEL METER:
9 KNOTS	B&K 7006	B&K 2131	

MICROPHONE:	STATIONARY OPERATION	HIGHWAY DRIVING	DRIVE-BY
B&K 4135	(X)	(X)	( )

INTERIOR	EXTERIOR	MICROPHONE LOCATION:
(X)	( )	AS DESCRIBED IN TABLE 2.4

						OCTAVE BAND CENTER FREQUENCIES (HZ)								
GEAR	RPM	SPEED KM/HR	dBA	dBB	dBC	ALL PASS	31.5	63	125	250	500	1000	2000	4000	8000
						HATCHES OPEN									
						DRIVER									
N	0	0	88	89	89	90	70	74	77	81	82	81	85	77	69
N	950	0	90	92	93	93	72	76	80	84	90	82	84	79	70
N	1350	0	92	93	93	94	76	78	79	84	85	86	87	79	72
D	1300	16	100	107	112	114	110	107	106	103	98	91	89	87	81
D	2200	32	105*	112	115	116	100	110	112*	109*	103*	97	93	91	87
D	2300	48	109*	117	121	121	99	117	116*	115*	106*	99	95	96	89
D	3000	64	111*	117	119	120	106	111	112*	116*	110*	102*	98	99	91
D	3100	69	113*	119	121	121	103	112	114*	118*	110*	103*	99	101*	92
						LOADER									
N	0	0	84	84	85	85	64	69	72	75	78	76	81	69	61
N	950	0	89	91	91	92	71	78	76	78	90	82	82	73	64
N	1350	0	88	90	90	91	76	79	77	77	87	82	82	77	65
D	1300	16	99	107	117	120	119	107	107	101	96	93	89	94	77
D	2200	32	104*	115	121	122	111	121	113*	107*	100	96	93	90	85
D	2300	48	108*	114	117	119	99	114	111	112*	105*	102*	99	96	90
D	3000	64	111*	115	118	120	108	110	113*	113*	109*	105*	99	93	86
D	3100	69	111*	116	118	119	107	110	114*	113*	108*	106*	99	94	87
						MAXIMUM ALLOWABLE LIMITS OF CATEGORY B, TABLE 2 OF MIL-STD-1474B(MI)								
			100				121	111	103	102	100	100	101	100	

LEVELS EXCEEDING MAXIMUM ALLOWABLE LIMITS OF CATEGORY B

ACOUSTICAL TEST DATA

TIME:	DATE:	TEST ITEM:
1030	20 MAR 1987	M1A1

TEST CONDUCTED BY:	TEST ITEM OPERATOR:	REG./MODEL NO:
P. PATTERSON	B. PARKER	A1

SERIAL NO.	ODOMETER:	HOUR METER:	TEST ITEM CONDITION:
A1	927	114	COMBAT LOADED

TEMPERATURE:	HUMIDITY:	TEST SITE:	SURFACE:
8.8 Deg. C.	36%	PERRYMAN TEST COURSE	ASPHALT

TERRAIN:	BAROMETERIC PRESSURE:	SKY COVER:	WIND DIRECTION:
FLAT	1030.54 mb	CLEAR	N

WIND VELOCITY:	TAPE RECORDER:	OCTAVE ANALYZER:	SOUND LEVEL METER:
9 KNOTS	B&K 7006	B&K 2131	

MICROPHONE:	STATIONARY OPERATION	HIGHWAY DRIVING	DRIVE-BY
B&K 4155	(X)	(X)	( )

INTERIOR	EXTERIOR	MICROPHONE LOCATION:
(X)	( )	AS DESCRIBED IN TABLE 2.4

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						OCTAVE BAND CENTER FREQUENCIES (HZ)								
GEAR	RPM	SPEED KM/HR	dBA	dBB	dBC	ALL PASS	31.5	63	125	250	500	1000	2000	4000	8000
						HATCHES OPEN									
						COMMANDER									
	0	0	81	82	83	84	62	69	72	78	75	75	76	66	57
	950	0	88	90	90	91	70	79	76	80	85	81	76	70	61
	1350	0	89	92	93	94	84	83	80	82	91	80	78	74	64
	1300	16	98	106	116	119	118	110	105	99	95	92	86	82	77
	2200	32	103*	115	122	123	111	122*	112*	106*	99	94	90	87	85
	2300	48	106*	113	117	118	99	116	109	110*	104*	99	95	92	87
	3000	64	110*	117	120	121	107	113	117*	113*	108*	102*	96	91	86
	3100	69	111*	118	121	122	106	113	119*	114*	109*	103*	95	92	87
						GUNNER									
	0	0	83	83	84	84	55	68	73	76	76	78	79	71	61
	950	0	84	87	87	88	55	70	66	68	87	72	74	66	57
	1350	0	92	93	94	96	84	83	81	80	92	82	86	78	68
	1300	16	98	104	111	113	110	107	104	97	95	93	89	86	77
	2200	32	104*	112	118	119	105	117	112*	104*	100	97	93	91	84
	2300	48	108*	114	117	118	94	112	115*	108*	105*	101*	98	95	88
	3000	64	110*	114	116	117	101	108	112*	110*	110*	104*	99	94	86
	3100	69	110*	114	116	117	99	108	112*	110*	109*	103*	99	96	87
						MAXIMUM ALLOWABLE LIMITS OF CATEGORY B, TABLE I OF MIL STD-1474B (MI)									
		100					121	111	103	102	100	100	100	100	

* LEVELS EXCEEDING MAXIMUM ALLOWABLE LIMITS OF CATEGORY B

ACOUSTICAL TEST DATA

TIME:	DATE:	TEST ITEM:
1030	20 MAR 1987	M1A1

TEST CONDUCTED BY:	TEST ITEM OPERATOR:	REG./MODEL NO:
P. PATTERSON	B. PARKER	A1

SERIAL NO.	ODOMETER:	HOUR METER:	TEST ITEM CONDITION:
A1	927	114	COMBAT LOADED

TEMPERATURE:	HUMIDITY:	TEST SITE:	SURFACE:
8.8 Deg. C.	36%	PERRYMAN TEST COURSE	ASPHALT

TERRAIN:	BAROMETERIC PRESSURE:	SKY COVER:	WIND DIRECTION:
FLAT	1030.54 mb	CLEAR	N

WIND VELOCITY:	TAPE RECORDER:	OCTAVE ANALYZER:	SOUND LEVEL METER:
9 KNOTS	B&K 7006	B&K 2131	

MICROPHONE:	STATIONARY OPERATION	HIGHWAY DRIVING	DRIVE-BY
B&K 4155	(X)	( )	( )

INTERIOR	EXTERIOR	MICROPHONE LOCATION:
(X)	( )	AS DESCRIBED IN TABLE 2.4

						OCTAVE BAND CENTER FREQUENCIES (HZ)								
GEAR	RPM	SPEED KM/HR	dBA	dBB	dBC	ALL PASS	31.5	63	125	250	500	1000	2000	4000	8000
						HATCHES CLOSED									
						DRIVER									
0	0		89	89	90	90	72	78	77	80	82	82	85	76	69
950	0		91	92	93	93	75	82	83	82	83	84	85	79	70
1350	0		91	92	92	93	75	81	80	83	87	84	87	80	73
						LOADER									
0	0		82	82	83	84	59	73	72	75	73	77	78	70	62
950	0		89	91	92	92	62	82	77	77	90	81	80	75	64
1350	0		89	91	91	92	63	81	78	77	89	83	82	74	65
						COMMANDER									
0	0		82	84	85	85	62	71	72	80	78	78	77	67	60
950	0		87	89	89	90	64	78	76	81	87	82	78	73	63
1350	0		87	89	90	90	66	80	76	82	87	81	79	76	64
						GUNNER									
0	0		83	83	84	85	56	71	74	76	76	76	78	70	62
950	0		93	95	95	95	58	79	77	77	94	82	85	77	65
1350	0		90	92	92	93	60	78	77	77	91	82	83	79	70
		100				MAXIMUM ALLOWABLE LIMITS OF CATEGORY B, TABLE 2 OF MIL-STD-1474B(MI)		121	111	103	102	100	100	100	100

IMPULSE NOISE LEVELS

Rd No.	Condition	Interior Commander Firing Tank P	B	S	D	Interior Loader Firing Tank P	B	S	D	Interior Gunner Firing Tank P	B	S	D
1	Hatches open,	168	168	69	E	171	130	32	642	168	154	112	E
2	0 degree	167	159	113	E	170	130	53	E	167	156	122	E
3	elevation.	169	157	59	E	169	140	64	E	167	154	117	E
4		168	158	72	E	169	131	88	E	167	185	101	E
5		168	158	103	E	169	131	70	E	167	185	122	E
6	Hatches open,	168	127	96	E	169	131	77	E	168	155	97	E
7	17 degree	171	94	47	943	169	120	65	E	167	127	159	E
8	elevation.	171	95	41	817	171	119	35	692	168	126	97	E
9		170	95	78	E	170	121	62	E	169	126	84	E
10		171	94	47	942	170	118	63	E	168	127	106	E
11	Hatches	F	F	F	F	F	F	F	F	F	F	F	F
12	closed,	154	G	E	E	156	G	E	E	154	162	E	E
13	17 degree	154	G	E	E	152	G	E	E	155	G	E	E
14	elevation	151	G	E	E	155	187	E	E	152	G	E	E
15		156	161	E	E	153	163	E	E	155	153	E	E
16	Hatches	153	G	E	E	149	G	E	E	152	G	E	E
17	closed,	152	G	E	E	149	G	E	E	152	G	E	E
18	0 degree	152	G	E	E	149	G	E	E	152	G	E	E
19	elevation	152	G	E	E	148	G	E	E	153	199	E	E
20		154	G	E	E	150	G	E	E	153	197	E	E

Rd No.	Condition	Exterior Commander Firing Tank P	B	S	D	Exterior Loader Firing Tank P	B	S	D	Exterior Rear Deck Firing Tank P	B	S	D
1	Hatches open,	174	162	0	0	176	86	0	0	170	F	F	F
2	0 degree	174	75	13	266	175	56	16	315	170	55	170	E
3	elevation.	175	49	19	371	177	47	7	143	170	93	69	E
4		175	51	19	384	175	67	9	186	170	142	43	866
5		174	50	28	552	174	81	13	254	170	99	70	E
6	Hatches open,	175	78	10	202	173	93	17	332	173	142	12	239
7	17 degree	175	45	18	351	178	70	0	0	172	81	38	761
8	elevation.	177	42	7	146	181	58	0	0	172	63	49	971
9		175	44	17	339	179	41	0	0	173	83	20	390
10		177	43	8	162	179	43	0	0	172	176	11	226
11	Hatches	Data Not Collected								F	F	F	F
12	closed,									172	90	29	581
13	17 degree									173	57	34	674
14	elevation									172	95	22	449
15										172	107	21	419
16	Hatches									170	94	114	E
17	closed,									170	88	86	E
18	0 degree									169	129	71	E
19	elevation									170	103	76	E
20										169	130	85	E

Rd No.	Condition	Exterior Commander Adjacent Tank P	B	S	D	Exterior Loader Adjacent Tank P	B	S	D	Interior Driver Firing Tank P	B	S	D
1	Hatches open,	175	33	28	581	176	49	13	255	169	142	63	E
2	0 degree	175	38	21	423	175	40	22	441	163	169	791	E
3	elevation.	176	59	10	191	177	48	8	162	169	145	51	E
4		176	39	11	229	175	56	14	272	169	142	57	E
5		176	47	12	240	175	89	8	161	169	142	57	E
6	Hatches open,	179	46	0	0	180	76	0	0	170	130	47	933
7	17 degree	178	41	0	0	180	37	0	0	170	87	70	E
8	elevation.	179	40	0	0	180	40	0	0	173	84	18	363
9		180	30	0	0	180	40	0	0	173	84	18	364
10		179	31	0	0	180	42	0	0	173	84	17	332
11	Hatches	F	F	F	F	F	F	F	F	F	F	F	F
12	closed,	179	45	0	0	180	109	0	0	163	132	954	E
13	17 degree	179	42	0	0	180	112	0	0	164	103	E	E
14	elevation	179	41	0	0	180	120	0	0	167	120	179	E
15		179	45	0	0	180	127	0	0	171	102	37	737
16	Hatches	173	47	36	728	175	193	0	0	172	124	18	359
17	closed,	175	48	15	309	175	183	0	0	157	130	E	E
18	0 degree	175	56	15	301	175	184	0	0	159	122	E	E
19	elevation	174	49	26	519	175	165	0	0	157	135	E	E
20		174	46	28	555	175	G	0	0	158	136	E	E

P = Peak magnitude (dB).
B = "B"-duration (msec).
S = Number of allowable exposures per day wearing single hearing protection.
D = Number of allowable exposures per day wearing double hearing protection.
E = Number of allowable exposures per day exceeds 1000.
F = Data unreducible or incomplete.
G = "B"-duration exceeds 200 milliseconds.

Environmental Conditions

24 May, 1600 Hours	26 May, 1400 Hours
Temperature 81 F, Humidity 66%	Temperature 66 F, Humidity 46%
Pressure 1007 mb, Wind 9 knots	Pressure 1200 mb, Wind 3 knots

NOTE: Round type and ammo lot number will be supplied by test director.

Impulse Noise Data

Position		Driver		Passenger		Gunner	
		Peak (dB)	B-duration (msec)	Peak (dB)	B-duration (msec)	Peak (dB)	B-duration (msec)
Muzzle[a] Direction	Rd No.						
0°	1	168	26.15	168	30.07	163	30.35
	2	169	26.65	169	29.63	163	30.08
	3	168	25.47	168	29.91	163	29.75
	4	169	26.58	169	27.45	163	27.62
	5	168	28.10	168	23.16	162	29.83
	Avg.	168	26.59	168	28.04	163	29.53
30°	1	169	23.15	168	17.78	-	-
	2	170	23.42	167	18.30	157	25.81
	3	170	23.30	167	21.28	155	29.92
	4	170	21.96	168	22.50	153	36.26
	5	170	23.37	167	18.29	154	34.24
	Avg.	170	23.04	167	19.63	155	31.56
60°	1	170	18.95	157	26.98	155	26.54
	2	170	19.07	157	27.57	155	43.06
	3	170	18.90	158	27.02	155	51.05
	4	170	19.07	158	27.50	155	50.68
	5	170	18.95	158	27.92	155	46.50
	Avg.	170	18.99	158	27.40	155	43.57
90°	1	160	27.30	151	29.63	156	33.64
	2	160	30.14	151	30.62	156	64.67
	3	161	29.29	151	29.54	156	64.49
	4	160	30.28	151	28.63	156	58.35
	5	159	29.43	152	28.56	156	47.96
	Avg.	160	29.29	151	29.40	156	53.82

[a]Front of vehicle oriented at 0°. Muzzle direction in clockwise direction.

Weapon: 20-mm Vulcan S/N 01 Ammo Lot No. LC 82J 281 012 (M246 HEIT-SD)
Atmospheric Conditions: Temp 33 °C, Wind 6.0 Km/hr, Relative humidity 85%
Barometric Pressure 1014mb

ACOUSTICAL TEST DATA

TIME: 1000 DATE: 26 July 85

TEST ITEM: Vulcan Wheeled Carrier

TEST CONDUCTED BY: Patterson/Clewer

TEST ITEM OPERATOR: G. Powers

REG./MODEL NO:

SERIAL NO:

ODOMETER:

HOUR METER:

TEST ITEM CONDITION:

TEMPERATURE: 31°C

HUMIDITY: 78%

TEST SITE: New Ant Hill

SURFACE: Dirt

TERRAIN: Flat

BAROMETRIC PRESSURE: 1014mb

SKY COVER: Clear

STATIONARY OPERATION (X)

HIGHWAY DRIVING ( )

DRIVE-BY ( )

WIND DIRECTION: NNE

WIND VELOCITY: 5 Km/hr

INTERIOR (X)

EXTERIOR ( )

TAPE RECORDER: B&K 7006

OCTAVE ANALYZER: B&K 2131

SOUND LEVEL METER: N/A

MICROPHONE: B&K 4155

MICROPHONE LOCATION: As indicated with guns over right side (30° Azimuth, 0° elevation)

GEAR	PRM	SPEED km/hr	dBA	dBB	dBC	ALL PASS	OCTAVE BAND CENTER FREQUENCY (in Hz) 31	63	125	250	500	1k	2k	4k	8k	REMARKS
			Driver's Position													
			129	131	133	133	115	124	127	127	126	123	122	120	119	Burst #1
			128	131	132	132	109	124	126	126	125	123	121	120	119	Burst #2
			129	131	133	133	111	124	127	127	126	124	122	121	120	Burst #3
			Passenger's Position													
			134	135	136	136	110	119	124	129	129	131	127	125	123	Burst #1
			135	136	137	137	114	120	124	130	130	131	128	125	124	Burst #2
			135	136	136	136	111	119	124	130	129	131	128	125	124	Burst #3
			Gunner's Position													
			128	130	131	131	109	116	122	123	127	124	119	116	113	Burst #1
			129	131	131	131	107	115	122	124	127	124	120	116	113	Burst #2
			129	131	131	132	107	117	122	123	128	124	120	117	113	Burst #3

ACOUSTICAL TEST DATA

TIME:	DATE:	TEST ITEM:
1400	26 MARCH 1987	M110A2 CREW BALLISTIC SHELTER

TEST CONDUCTED BY:	TEST ITEM OPERATOR:	REG./MODEL NO:
E. RICHARDSON	SGT. ROSE	M110A2

SERIAL NO.	ODOMETER:	HOUR METER:	TEST ITEM CONDITION:
#2			SEE BELOW

TEMPERATURE:	HUMIDITY:	TEST SITE:	SURFACE:
65 F	46%	PERRYMAN	PAVED

TERRAIN:	BAROMETERIC PRESSURE:	SKY COVER:	WIND DIRECTION:
FLAT	1011 mb	CLEAR	SE

WIND VELOCITY:	TAPE RECORDER:	OCTAVE ANALYZER:	SOUND LEVEL METER:
6 KNOTS	B&K 7006	B&K 2131	

MICROPHONE:	STATIONARY OPERATION	HIGHWAY DRIVING	DRIVE-BY
B&K 4155	( )	(X)	( )

INTERIOR	EXTERIOR	MICROPHONE LOCATION:
(X)	( )	ASSISTANT GUNNER

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						OCTAVE BAND CENTER FREQUENCIES (HZ)								
GEAR	RPM	SPEED KM/HR	dBA	dBB	dBC	ALL PASS	31.5	63	125	250	500	1000	2000	4000	8000
WINDOWS, DOORS AND REAR CANVAS OPEN															
		IDLE	84	93	97	97	88	82	96	87	79	7-	70	63	56
R		8	97	101	103	104	91	95	97	100	9[illegible]	9[illegible]	87	79	68
R		16	101	105	109	110	101	101	104	104	98	9[illegible]	92	86	76
R		24	103	109	114	115	102	113	106	106	100	9[illegible]	93	88	79
R		32	104	109	113	114	97	110	107	107	100	9[illegible]	93	87	79
R		40	105	110	113	114	98	108	107	108	102	9[illegible]	94	88	79
R		48	105	111	113	114	99	106	108	109	103	9[illegible]	96	89	82
R		56	108	114	116	116	100	105	112	112*	105	101	98	93	86
WINDOWS, DOORS AND REAR CANVAS CLOSED															
		IDLE	86	94	97	98	91	85	94	92	79	75	70	63	55
R		8	104	108	111	113	105	103	106	106	100	99	96	89	80
R		16	104	110	114	116	113	106	107	108	100	98	95	88	80
R		24	107	114	119	121	114	117	109	112*	102	100	96	90	82
R		32	105	111	115	116	107	111	109	108	101	99	95	89	81
R		40	108	114	117	118	108	111	112	112*	104	101	98	91	81
R		48	108	114	117	119	110	111	113	112*	105	102	99	92	83
R		56	110*	116	119	120	110	109	116	114*	106	103	101	94	85
						MAXIMUM ALLOWABLE LIMITS OF CATEGORY A, TABLE 2 OF MIL-STD-1474B(MI)									
			108				130	119	110	106	105	112	110	110	

IS EXCEEDING MAXIMUM ALLOWABLE LIMITS OF CATEGORY A

ACOUSTICAL TEST DATA

TIME:	DATE:	TEST ITEM:
1400	26 MARCH 1987	M110A2 CREW BALLISTIC SHELTER

TEST CONDUCTED BY:	TEST ITEM OPERATOR:	REG./MODEL NO:
E. RICHARDSON	SGT. ROSE	M110A2

SERIAL NO.	ODOMETER:	HOUR METER:	TEST ITEM CONDITION:
#2			SEE BELOW

TEMPERATURE:	HUMIDITY:	TEST SITE:	SURFACE:
65 F	46%	PERRYMAN	PAVED

TERRAIN:	BAROMETERIC PRESSURE:	SKY COVER:	WIND DIRECTION:
FLAT	1011 mb	CLEAR	SE

WIND VELOCITY:	TAPE RECORDER:	OCTAVE ANALYZER:	SOUND LEVEL METER:
6 KNOTS	B&K 7006	B&K 2131	

MICROPHONE:	STATIONARY OPERATION	HIGHWAY DRIVING	DRIVE-BY
B&K 4155	( )	(X)	( )

INTERIOR	EXTERIOR	MICROPHONE LOCATION:
(X)	( )	LOADER

****

							OCTAVE BAND CENTER FREQUENCIES (HZ)								
GEAR	RPM	SPEED KM/HR	dBA	dBB	dBC	ALL PASS	31.5	63	125	250	500	1000	2000	4000	8000
						WINDOWS, DOORS AND REAR CANVAS OPEN									
	IDLE	82	90	94	96	91	82	93	83	79	75	69	61	56	
1	8	98	103	106	107	90	97	101	102	94	93	89	83	72	
2	16	102	107	111	112	99	104	108	102	99	96	93	88	78	
1	24	104	110	114	115	102	113	109	104	102	99	95	90	81	
2	32	104	110	114	115	100	111	109	104	102	99	95	90	81	
1	40	105	110	113	115	100	110	109	104	103	100	96	90	81	
2	48	106	110	114	116	104	109	110	105	104	101	96	90	82	
1	56	108	113	116	118	108	108	113	108	106	102	99	93	86	
						WINDOWS, DOORS AND REAR CANVAS CLOSED									
	IDLE	81	87	93	95	93	83	87	83	80	75	71	63	56	
2	8	104	106	108	110	102	101	101	101	100	99	97	92	83	
1	16	104	107	111	113	109	103	104	102	101	99	96	90	82	
2	24	106	110	115	117	112	112	106	104	103	101	98	92	84	
1	32	105	108	111	112	103	105	105	103	102	100	96	91	83	
1	40	107	110	113	114	105	108	108	106	105	102	99	93	83	
1	48	108	112	114	116	106	107	110	106	106	103	100	94	86	
1	56	110*	114	116	117	106	106	113	108	108*	105	102	96	87	
						MAXIMUM ALLOWABLE LIMITS OF CATEGORY A, TABLE 2 OF MIL-STD-1474B(MI)									
		108					130	119	110	106	105	112	110	113	

LS EXCEEDING MAXIMUM ALLOWABLE LIMITS OF CATEGORY A

ACOUSTICAL TEST DATA

TIME:	DATE:	TEST ITEM:
1400	26 MARCH 1987	M110A2 CREW BALLISTIC SHELTER

TEST CONDUCTED BY:	TEST ITEM OPERATOR:	REG./MODEL NO:
E. RICHARDSON	SGT. ROSE	M110A2

SERIAL NO.	ODOMETER:	HOUR METER:	TEST ITEM CONDITION:
#2			SEE BELOW

TEMPERATURE:	HUMIDITY:	TEST SITE:	SURFACE:
65 F	46%	PERRYMAN	PAVED

TERRAIN:	BAROMETERIC PRESSURE:	SKY COVER:	WIND DIRECTION:
FLAT	1011 mb	CLEAR	SE

WIND VELOCITY:	TAPE RECORDER:	OCTAVE ANALYZER:	SOUND LEVEL METER:
6 KNOTS	B&K 7006	B&K 2131	

MICROPHONE:	STATIONARY OPERATION	HIGHWAY DRIVING	DRIVE-BY
B&K 4155	( )	(X)	( )

INTERIOR	EXTERIOR	MICROPHONE LOCATION:
(X)	( )	GUNNER

****

						OCTAVE BAND CENTER FREQUENCIES (HZ)								
GEAR	RPM	SPEED KM/HR	dBA	dBB	dBC	ALL PASS	31.5	63	125	250	500	1000	2000	4000	8000
						WINDOWS, DOORS AND REAR CANVAS OPEN									
	IDLE		84	92	96	97	90	82	94	87	80	78	73	64	58
3		8	96	100	102	103	92	96	96	97	91	92	88	82	75
3		16	103	107	109	110	98	103	104	104	98	98	95	89	80
3		24	105	110	114	115	102	112	108	106	101	100	97	91	83
3		32	105	110	113	114	98	109	105	107	101	100	97	92	83
3		40	107	111	114	115	99	110	107	108	102	101	99	92	84
3		48	107	111	114	115	101	109	109	108	104	102	100	93	87
3		56	110*	114	117	118	105	106	112	112*	105	104	102	96	91
						WINDOWS, DOORS AND REAR CANVAS CLOSED									
	IDLE		85	93	98	100	97	84	95	87	79	79	74	65	57
3		8	105	106	109	115	104	103	101	101	99	101	98	92	84
3		16	105	109	112	114	107	105	106	105	101	100	99	92	83
3		24	107	112	117	119	112	115	108	107	102	102	100	93	85
3		32	106	110	113	115	107	108	107	106	102	101	98	92	84
3		40	108	112	115	117	108	111	109	108	104	103	101	94	85
3		48	110*	114	117	119	110	113	111	109	106	105	103	96	88
3		56	111*	115	117	118	110	108	112	111*	107*	106*	104	97	89
						MAXIMUM ALLOWABLE LIMITS OF CATEGORY A, TABLE 2 OF MIL-STD-1474B(MI)									
			108				130	119	110	106	105	112	110	110	

ILS EXCEEDING MAXIMUM ALLOWABLE LIMITS OF CATEGORY A

ACOUSTICAL TEST DATA

TIME:	DATE:	TEST ITEM:
1400	26 MARCH 1987	M110A2 CREW BALLISTIC SHELTER

TEST CONDUCTED BY:	TEST ITEM OPERATOR:	REG./MODEL NO:
E. RICHARDSON	SGT. ROSE	M110A2

SERIAL NO.	ODOMETER:	HOUR METER:	TEST ITEM CONDITION:
#2			SEE BELOW

TEMPERATURE:	HUMIDITY:	TEST SITE:	SURFACE:
65 F	46%	PERRYMAN	PAVED

TERRAIN:	BAROMETERIC PRESSURE:	SKY COVER:	WIND DIRECTION:
FLAT	1011 mb	CLEAR	SE

WIND VELOCITY:	TAPE RECORDER:	OCTAVE ANALYZER:	SOUND LEVEL METER:
6 KNOTS	B&K 7006	B&K 2131	

MICROPHONE:	STATIONARY OPERATION	HIGHWAY DRIVING	DRIVE-BY
B&K 4155	( )	(X)	( )

INTERIOR	EXTERIOR	MICROPHONE LOCATION:
(X)	( )	COMMANDER

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							OCTAVE BAND CENTER FREQUENCIES (HZ)							
GEAR	RPM	SPEED KM/HR	dBA	dBB	dBC	ALL PASS	31.5	63	125	250	500	1000	2000	4000	8000
						WINDOWS, DOORS AND REAR CANVAS OPEN									
	IDLE		87	95	98	98	89	83	96	91	83	79	75	67	61
R	8		98	104	106	106	88	96	102	102	95	92	89	83	75
R	16		105	110	113	114	95	104	109	109	101	98	96	92	83
R	24		108	114	117	117	99	109	113	112*	104	100	97	94	85
R	32		108	114	116	117	95	110	111	112*	104	101	98	94	85
R	40		109*	115	117	117	95	107	112	113*	106	101	99	95	87
R	48		110*	115	117	118	96	110	114	112*	107*	102	101	96	92
R	56		112*	118	120	121	98	107	117	116*	109*	105	103	99	97
						WINDOWS, DOORS AND REAR CANVAS CLOSED									
	IDLE		87	96	100	101	93	81	99	90	83	78	73	64	57
R	8		105	108	110	111	98	100	105	103	102	100	99	93	84
R	16		106	111	113	114	101	102	109	108	104	100	98	91	83
R	24		108	112	115	116	105	110	110	110	106	102	99	93	84
R	32		107	112	114	115	99	106	110	109	104	101	98	93	84
R	40		109*	114	116	117	101	106	112	112*	107*	103	101	94	84
R	48		111*	115	118	118	102	110	114	113*	108*	105	102	96	88
R	56		112*	117	119	120	102	106	116	114*	109*	106*	103	97	89
						MAXIMUM ALLOWABLE LIMITS OF CATEGORY A, TABLE 2 OF MIL-STD-1474B(MI)									
			108			130	119	110	106	105	112	110	110		

ILS EXCEEDING MAXIMUM ALLOWABLE LIMITS OF CATEGORY A

ACOUSTICAL TEST DATA

TIME:	DATE:	TEST ITEM:
1330	20 MARCH 89	M60

TEST CONDUCTED BY:	TEST ITEM OPERATOR:	REG./MODEL NO:
R. WALRATH	D. KESTLER	970

SERIAL NO.	ODOMETER:	HOUR METER:	TEST ITEM CONDITION:
	1702	121.7	COMBAT WEIGHT

TEMPERATURE:	HUMIDITY:	TEST SITE:	SURFACE:
45 DEGREES F	45%	PERRYMAN	PAVED

TERRAIN:	BAROMETERIC PRESSURE:	SKY COVER:	WIND DIRECTION:
LEVEL	1026.4 MILIBARS	OVERCAST	SW

WIND SPEED:	TAPE RECORDER:	OCTAVE ANALYZER:	SOUND LEVEL METER:
10 KNOTS	RACAL	B&K 2131	

MICROPHONE:	STATIONARY OPERATION	HIGHWAY DRIVING	DRIVE-BY
B&K 4155	( )	(X)	( )

INTERIOR	EXTERIOR	MICROPHONE LOCATION:
(X)	( )	DRIVER'S HELMET

****

						OCTAVE BAND CENTER FREQUENCIES (HZ)									
GEAR	RPM	SPEED KM/HR	dBA	dBB	dBC	ALL PASS	31.5	63	125	250	500	1000	2000	4000	8000
HATCHES OPEN															
N		IDLE	85	90	94	95	93	85	87	86	83	79	78	72	65
D		8	94	99	104	105	101	99	98	94	93	88	86	78	73
D		16	101*	107	111	112	108	105	107	102	100	94	91	87	79
D		24	108*	112	119	121	120	108	110	107*	106*	101*	99	97	91
D		32	108*	114	118	119	107	116	111	109*	106*	103*	97	94	87
D		40	109*	114	116	116	104	105	111	110*	110*	101*	96	93	87
D		48	113*	117	119	119	105	108	112*	114*	114*	106*	98	94	86
D		49	113*	117	119	119	104	111	113*	113*	114*	106*	98	95	86
HATCHES CLOSED															
N		IDLE	86	91	95	96	92	85	90	88	84	78	77	74	66
D		8	95	101	106	107	101	100	102	96	93	88	84	78	77
D		16	103*	108	112	112	103	101	110	104*	99	97	94	90	82
D		24	108*	113	116	117	112	109	112*	107*	106*	102*	100	98	91
D		32	109*	114	117	117	107	109	113*	112*	106*	103*	98	95	89
D		40	111*	115	118	118	108	104	115*	111*	111*	103*	97	94	87
D		48	113*	118	120	120	107	108	115*	116*	112*	105*	98	95	87
D		49	114*	119	121	121	110	106	117*	116*	114*	106*	99	95	88
						MAXIMUM ALLOWABLE LIMITS OF MIL-STD-1474B(MI), TABLE 2, CATEGORY B									
			100				121	111	103	102	100	100	100	100	

*LEVELS EXCEEDING MAXIMUM ALLOWABLE LIMITS OF CATEGORY B

ACOUSTICAL TEST DATA

TIME:	DATE:	TEST ITEM:
1330	20 MARCH 89	M60

TEST CONDUCTED BY:	TEST ITEM OPERATOR:	REG./MODEL NO:
R. WALRATH	D. KESTLER	970

SERIAL NO.	ODOMETER:	HOUR METER:	TEST ITEM CONDITION:
	1702	121.7	COMBAT WEIGHT

TEMPERATURE:	HUMIDITY:	TEST SITE:	SURFACE:
45 DEGREES F	45%	PERRYMAN	PAVED

TERRAIN:	BAROMETERIC PRESSURE:	SKY COVER:	WIND DIRECTION:
LEVEL	1026.4 MILIBARS	OVERCAST	SW

WIND SPEED:	TAPE RECORDER:	OCTAVE ANALYZER:	SOUND LEVEL METER:
10 KNOTS	RACAL	B&K 2131	

MICROPHONE:	STATIONARY OPERATION	HIGHWAY DRIVING	DRIVE-BY
B&K 4155	( )	(X)	( )

INTERIOR	EXTERIOR	MICROPHONE LOCATION:
(X)	( )	LOADER'S HELMET

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						OCTAVE BAND CENTER FREQUENCIES (HZ)								
GEAR	RPM	SPEED KM/HR	dBA	dBB	dBC	ALL PASS	31.5	63	125	250	500	1000	2000	4000	8000
						HATCHES OPEN									
		IDLE	83	91	96	97	93	87	93	86	81	75	72	64	62
		8	95	100	104	106	102	98	99	95	92	89	87	80	75
		16	100	108	113	114	110	106	109	102	97	94	90	85	78
		24	108*	112	118	120	118	108	110	106*	104*	101*	101*	97	91
		32	109*	113	117	117	104	112	112*	109*	106*	103*	100	96	91
		40	108*	112	114	115	104	101	110	109*	108*	102*	95	89	82
		48	111*	116	119	119	103	107	116*	112*	112*	104*	97	91	84
		49	111*	116	119	119	102	108	116*	112*	111*	106*	97	91	84
						HATCHES CLOSED									
		IDLE	83	91	95	96	90	87	93	86	81	75	72	64	62
		8	93	99	104	105	98	99	100	95	92	86	84	77	73
		16	101*	109	113	113	99	107	111	102	97	94	90	83	74
		24	106*	110	114	115	110	110	108	103	104*	100	98	93	84
		32	108*	112	114	114	99	104	108	109*	105*	102*	98	94	87
		40	108*	112	114	114	99	98	109	108*	109*	103*	95	87	79
		48	110*	114	116	116	98	102	110	112*	110*	103*	96	87	79
		49	113*	117	119	120	103	111	114*	114*	112*	107*	100	92	85
						MAXIMUM ALLOWABLE LIMITS OF MIL-STD-1474B(MI), TABLE 2, CATEGORY B									
			100					121	111	103	102	100	100	100	100

DELS EXCEEDING MAXIMUM ALLOWABLE LIMITS OF CATEGORY B

ACOUSTICAL TEST DATA

TIME:	DATE:	TEST ITEM:
1330	20 MARCH 89	M60

TEST CONDUCTED BY:	TEST ITEM OPERATOR:	REG./MODEL NO:
R. WALRATH	D. KESTLER	970

SERIAL NO.	ODOMETER:	HOUR METER:	TEST ITEM CONDITION:
	1702	121.7	COMBAT WEIGHT

TEMPERATURE:	HUMIDITY:	TEST SITE:	SURFACE:
45 DEGREES F	45%	PERRYMAN	PAVED

TERRAIN:	BAROMETERIC PRESSURE:	SKY COVER:	WIND DIRECTION:
LEVEL	1026.4 MILIBARS	OVERCAST	SW

WIND SPEED:	TAPE RECORDER:	OCTAVE ANALYZER:	SOUND LEVEL METER:
10 KNOTS	RACAL	B&K 2131	

MICROPHONE:	STATIONARY OPERATION	HIGHWAY DRIVING	DRIVE-BY
B&K 4155	( )	(X)	( )

INTERIOR	EXTERIOR	MICROPHONE LOCATION:
(X)	( )	COMMANDER'S POSITION

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						OCTAVE BAND CENTER FREQUENCIES (HZ)								
GEAR	RPM	SPEED KM/HR	dBA	dBB	dBC	ALL PASS	31.5	63	125	250	500	1000	2000	4000	8000
						HATCHES OPEN									
N		IDLE	83	93	97	98	89	89	96	82	80	71	67	61	59
D		8	96	102	107	108	102	102	104	92	91	89	90	83	80
D		16	100	109	114	115	109	109	112*	97	96	92	91	88	85
D		24	110*	114	118	119	114	110	115*	104*	105*	102*	106*	102*	96
						HATCHES CLOSED									
N		IDLE	84	94	98	98	84	93	96	88	80	75	70	63	60
D		8	95	102	108	108	93	106	104	96	91	87	86	81	77
D		16	102*	110	114	115	96	107	113*	103	96	95	91	86	80
D		24	107*	112	117	118	110	115	113*	105*	101	101*	100	96	90
						MAXIMUM ALLOWABLE LIMITS OF MIL-STD-1474B(MI), TABLE 2, CATEGORY B									
			100				121	111	103	102	100	100	[illegible]		100

VELS EXCEEDING MAXIMUM ALLOWABLE LIM[illegible] CATEGORY B

ACOUSTICAL TEST DATA

TIME:	DATE:	TEST ITEM:
1300	28 APRIL 89	M109 (HIP) HOWITZER

TEST CONDUCTED BY:	TEST ITEM OPERATOR:	REG./MODEL NO:
P. PATTERSON	S. SPANGLER	A3E2

SERIAL NO.	ODOMETER:	HOUR METER:	TEST ITEM CONDITION:
2207	146	81.4	COMBAT LOADED

TEMPERATURE:	HUMIDITY:	TEST SITE:	SURFACE:
18 DEGREES C	33%	PERRYMAN TEST COURSE	PAVED

TERRAIN:	BAROMETERIC PRESSURE:	SKY COVER:	WIND DIRECTION:
LEVEL	1013 MILLIBARS	PARTLY CLOUDLY	NORTH NORTHEAST

WIND SPEED:	TAPE RECORDER:	OCTAVE ANALYZER:	SOUND LEVEL METER:
5 KNOTS	B&K 7006	B&K 2131	

MICROPHONE:	STATIONARY OPERATION	HIGHWAY DRIVING	DRIVE-BY
B&K 4155	(X)	(X)	( )

INTERIOR	EXTERIOR	MICROPHONE LOCATION:
(X)	( )	DRIVERS POSITION

						OCTAVE BAND CENTER FREQUENCIES (HZ)									
GEAR	RPM	SPEED KM/HR	dBA	dBB	dBC	ALL PASS	31.5	63	125	250	500	1000	2000	4000	8000
						AMBIENT									
			58	59	64	70	64	56	55	47	48	54	48	50	53
						HATCHES OPEN; NO EQUIPMENT ON									
N	800		94	99	102	102	84	94	99	92	90	90	85	80	80
						HATCHES OPEN; VENT BLOWER ON "INTAKE"									
N	800		97	100	103	103	84	90	101	92	94	93	87	80	80
						HATCHES OPEN; MCS ON "COOL"									
N	800		97	100	103	103	83	92	100	93	94	93	88	81	80
						HATCHES OPEN; MCS ON "COOL"; VENT BLOWER ON "INTAKE"; HYDRAULICS ON									
N	800		97	100	102	103	85	96	99	92	94	94	88	82	80
						HATCHES OPEN; MCS ON "COOL"; VENT BLOWER ON "INTAKE"									
D		5	100	105	107	107	92	97	103	102	96	96	90	82	80
D		10	104*	106	109	109	99	103	103	100	101	100	94	90	90
D		15	108*	110	113	114	108	104	102	106*	105*	106*	98	91	90
D		20	109*	112	113	114	104	105	104	106*	108*	106*	100	92	90
D		25	114*	116	119	120	112	113	108	110*	112*	110*	104*	100	100
D		30	112*	115	118	119	104	114	108	111*	110*	107*	101*	94	90
D		35	114*	116	118	118	111	111	108	112*	112*	110*	104*	100	100
						MAXIMUM ALLOWABLE LIMITS OF MIL-STD-1474B(MI), TABLE 2, CATEGORY B									
			100			121	111	103	102	100	100	100	100		

*LEVELS EXCEEDING MAXIMUM ALLOWABLE LIMITS OF CATEGORY B

ACCOUSTICAL TEST DATA

TIME:	DATE:	TEST ITEM:
1330	20 MARCH 89	M60

TEST CONDUCTED BY:	TEST ITEM OPERATOR:	REG./MODEL NO:
R. WALRATH	D. KESTLER	970

SERIAL NO.	ODOMETER:	HOUR METER:	TEST ITEM CONDITION:
	1702	121.7	COMBAT WEIGHT

TEMPERATURE:	HUMIDITY:	TEST SITE:	SURFACE:
45 DEGREES F	45%	PERRYMAN	PAVED

TERRAIN:	BAROMETERIC PRESSURE:	SKY COVER:	WIND DIRECTION:
LEVEL	1026.4 MILIBARS	OVERCAST	SW

WIND SPEED:	TAPE RECORDER:	OCTAVE ANALYZER:	SOUND LEVEL METER:
10 KNOTS	RACAL	B&K 2131	

MICROPHONE:	STATIONARY OPERATION	HIGHWAY DRIVING	DRIVE-BY
B&K 4155	( )	(X)	( )

INTERIOR	EXTERIOR	MICROPHONE LOCATION:
(X)	( )	GUNNER'S POSITION

						OCTAVE BAND CENTER FREQUENCIES (HZ)								
GEAR	RPM	SPEED KM/HR	dBA	dBB	dBC	ALL PASS	31.5	63	125	250	500	1000	2000	4000	8000
HATCHES OPEN															
N		IDLE	86	96	100	101	94	93	98	91	82	73	68	60	60
D		8	98	105	110	110	104	106	105	100	93	91	90	78	72
D		16	103*	112	118	119	115	112	114*	107*	98	93	88	81	76
D		24	109*	117	122	124	121	113	118*	114*	105*	101*	99	93	88
D		32	109*	116	120	121	106	118	114*	114*	106*	101*	97	92	87
D		40	110*	117	120	120	107	111	117*	114*	108*	102*	93	85	80
D		48	115*	121	124	124	108	115	122*	117*	115*	105*	96	87	82
D		49	114*	121	125	125	106	120	122*	118*	111*	105*	95	87	82
HATCHES CLOSED															
N		IDLE	87	97	101	102	90	93	100	91	81	75	69	60	60
D		8	95	103	108	109	101	105	104	99	92	86	82	74	71
D		16	103*	113	117	117	104	110	115*	107*	98	94	89	81	76
D		24	108*	115	120	121	116	114	116*	111*	105*	101*	98	92	86
D		32	110*	116	119	119	105	113	114*	114*	107*	103*	98	93	89
D		40	111*	117	120	120	105	113	117*	113*	110*	103*	94	86	81
D		48	114*	121	126	127	105	125*	119*	117*	113*	105*	96	88	83
D		49	117*	124	128	128	108	125*	120*	123*	112*	109*	97	88	83
MAXIMUM ALLOWABLE LIMITS OF MIL-STD-1474B(MI), TABLE 2, CATEGORY B															
			100				121	111	103	102	100	100	100	100	

LEVELS EXCEEDING MAXIMUM ALLOWABLE LIMITS OF CATEGORY B

Impulse Noise Data for M60 Tank Firing 105-mm M456A2 HEAT Projectiles[a]

TRIAL	POSITION 1 PEAK (dB)	POSITION 1 DURATION (mS) A	POSITION 1 DURATION (mS) B	POSITION 2 PEAK (dB)	POSITION 2 DURATION (mS) A	POSITION 2 DURATION (mS) B	POSITION 3 PEAK (dB)	POSITION 3 DURATION (mS) A	POSITION 3 DURATION (mS) B	POSITION 4 PEAK (dB)	POSITION 4 DURATION (mS) A	POSITION 4 DURATION (mS) B
1	169	5.79	54.20	170	6.27	63.49	164	9.33	88.72	161	28.44	139.30
2	168	6.23	62.30	169	6.30	63.05	166	9.91	74.55	160	28.66	158.48
3	169	5.97	61.57	169	6.09	58.15	164	9.10	88.65	160	27.96	160.32
4	168	6.08	59.94	169	6.10	62.38	165	9.39	87.88	160	28.20	143.38
5	168	5.92	63.94	169	6.14	62.98	166	9.46	86.16	160	28.78	150.86
AVG.	168	6.00	60.39	169	6.18	62.01	165	9.44	85.19	160	28.41	150.47

TRIAL	POSITION 5 PEAK (dB)	POSITION 5 DURATION (mS) A	POSITION 5 DURATION (mS) B	POSITION 6 PEAK (dB)	POSITION 6 DURATION (mS) A	POSITION 6 DURATION (mS) B	POSITION 7[b]	POSITION # 8 PEAK (dB)	POSITION # 9 PEAK (dB)
1	163	18.44	165.92	161	31.02	162.74	--------	166	161
2	163	17.88	167.18	160	30.68	153.00	--------	165	161
3	162	17.54	164.14	161	24.96	152.56	--------	166	163
4	163	17.16	163.92	160	29.94	151.76	--------	165	162
5	163	17.82	163.24	160	31.08	151.98	--------	165	161
AVG.	163	17.77	164.88	161	29.54	154.41	--------	165	162

[a] POSITION 1,2= 3 meters (10 ft) to the left (position 1) and right (position 2) of the rear corners of the tank, 1.5 meters (5 ft) above the ground.

POSITION 3 = Commander's Head Position (80 cm above seat)
POSITION 4 = Loader's Head Position (80 cm above seat)
POSITION 5 = Driver's Head Position (15 cm forward of driver's headrest)
POSITION 6 = Gunner's Head Position (80 cm above seat)
POSITION 7 = Commander's Head Position,Open Hatch Configuration (30 cm above hatch plane)
POSITION 8 = 12.2 meters (40 ft) from tank along 225° (magnetic) radial relative to the center of the tank (tube at 0°), 1.5 meters (5 ft) above the ground.
POSITION 9 = 24.4 meters (80 ft) from tank along 225° (magnetic) radial relative to the center of the tank (tube at 0°), 1.5 meters (5 ft) above the ground.

Note: Hatches for the Loader and Commander were open. Driver's hatch was closed.

[b] No valid data due to blast gage malfunction.

IMPULSE NOISE LEVELS (INTERIOR)

Position	Round No. 1 P[a]	1 B[b]	1 S[c]	1 D[d]	2 P[a]	2 B[b]	2 S[c]	2 D[d]	3 P[a]	3 B[b]	3 S[c]	3 D[d]
Zone 5 - 800 mils												
Commander	[e] -	-	-	-	159	>200.00	>1K	>1K	161	84.44	>1K	>1K
Loader	161	174.16	>1K	>1K	160	87.68	>1K	>1K	160	99.02	>1K	>1K
Gunner	160	88.94	>1K	>1K	159	81.64	>1K	>1K	158	91.96	>1K	>1K
Asst. Gunner	159	>200.00	>1K	>1K	159	128.78	>1K	>1K	-	-	-	-
Zone 5 - 1069 mils												
Commander	158	>200.00	>1K	>1K	159	195.60	>1K	>1K	158	>200.00	>1K	>1K
Loader	159	155.36	>1K	>1K	159	>200.00	>1K	>1K	159	>200.00	>1K	>1K
Gunner	158	143.38	>1K	>1K	158	179.88	>1K	>1K	158	166.62	>1K	>1K
Asst. Gunner	159	167.64	>1K	>1K	158	>200.00	>1K	>1K	157	>200.00	>1K	>1K
Zone 9 - 200 mils												
Commander	166	77.78	638	>1K	166	76.09	688	>1K	166	77.66	701	>1K
Loader	166	177.36	204	>1K	166	87.72	432	>1K	166	98.52	406	>1K
Gunner	166	96.56	380	>1K	167	82.18	374	>1K	166	78.26	480	>1K
Asst. Gunner	167	>200.00	120	>1K	168	135.32	133	>1K	168	>200.00	69	>1K
Zone 9 - 800 mils												
Commander	168	82.26	236	>1K	169	115.76	104	>1K	168	93.48	166	>1K
Loader	168	96.78	138	>1K	168	92.92	159	>1K	170	96.98	83	>1K
Gunner	167	82.76	354	>1K	167	83.44	367	>1K	167	129.08	171	>1K
Asst. Gunner	-	-	-	-	-	-	-	-	-	-	-	-
Zone 9 - 1069 mils												
Commander	168	188.88	75	>1K	168	73.22	263	>1K	166	>200.00	174	>1K
Loader	168	83.28	184	>1K	168	98.20	178	>1K	169	147.68	72	>1K
Gunner	166	111.88	328	>1K	166	124.64	311	>1K	166	141.58	209	>1K
Asst. Gunner	-	-	-	-	-	-	-	-	-	-	-	-

[a] Peak decibels (dB)

[b] "B" - duration (msec)

[c] Maximum number of rounds allowed with single hearing protection.

[d] Maximum number of rounds allowed with double hearing protection.

[e] "-" indicates data were lost during recording.

ACOUSTICAL TEST DATA

TIME:	DATE:	TEST ITEM:
1300	28 APRIL 89	M109 (HIP) HOWITZER

TEST CONDUCTED BY:	TEST ITEM OPERATOR:	REG./MODEL NO:
P. PATTERSON	S. SPANGLER	A3E2

SERIAL NO.	ODOMETER:	HOUR METER:	TEST ITEM CONDITION:
2207	146	81.4	COMBAT LOADED

TEMPERATURE:	HUMIDITY:	TEST SITE:	SURFACE:
18 DEGREES C	33%	PERRYMAN TEST COURSE	PAVED

TERRAIN:	BAROMETERIC PRESSURE:	SKY COVER:	WIND DIRECTION:
LEVEL	1013 MILLIBARS	PARTLY CLOUDLY	NORTH NORTEAST

WIND SPEED:	TAPE RECORDER:	OCTAVE ANALYZER:	SOUND LEVEL METER:
5 KNOTS	B&K 7006	B&K 2131	

MICROPHONE:	STATIONARY OPERATION	HIGHWAY DRIVING	DRIVE-BY
B&K 4155	(X)	(X)	( )

INTERIOR	EXTERIOR	MICROPHONE LOCATION:
(X)	( )	LEFT CANNONEER SEAT

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							OCTAVE BAND CENTER FREQUENCIES (HZ)								
GEAR	RPM	SPEED KM/HR	dBA	dBB	dBC	ALL PASS	31.5	63	125	250	500	1000	2000	4000	8000
AMBIENT															
			57	58	63	67	63	57	51	42	46	54	46	48	51
HATCHES OPEN; NO EQUIPMENT ON															
N	800		84	88	91	92	85	85	88	81	82	80	72	70	70
HATCHES OPEN; VENT BLOWER ON "INTAKE"															
N	800		93	94	95	96	85	82	90	82	86	91	86	74	70
HATCHES OPEN; MCS ON "COOL"															
N	800		88	91	93	94	84	86	88	84	87	83	80	75	70
HATCHES OPEN; MCS ON "COOL"; VENT BLOWER ON "INTAKE"; HYDRAULICS ON															
N	800		96	97	99	99	85	92	94	86	89	93	80	80	80
HATCHES OPEN; MCS ON "COOL"; VENT BLOWER ON "INTAKE"															
D		5	95	97	101	103	100	92	91	91	91	92	87	80	80
D		10	99	101	105	110	104	98	95	95	95	94	90	90	90
D		15	101*	107	118	121	121	101	100	100	99	95	92	90	90
D		20	104*	108	112	114	109	107	105	102	104*	98	95	90	90
D		25	111*	114	118	120	114	115	109	108*	110*	105*	102*	100	100
D		30	109*	113	115	116	106	106	108	105*	109*	103*	100	92	90
D		35	111*	114	116	116	108	109	109	109*	109*	104*	101*	100	100
MAXIMUM ALLOWABLE LIMITS OF MIL-STD-1474B(MI) TABLE 2, CATEGORY B															
			100					121	111	103	102	100	101	100	100

*LEVELS EXCEEDING MAXIMUM ALLOWABLE LIMITS OF CATEGORY B

ACOUSTICAL TEST DATA

TIME:	DATE:	TEST ITEM:
1300	28 APRIL 89	M109 (HIP) HOWITZER

TEST CONDUCTED BY:	TEST ITEM OPERATOR:	REG./MODEL NO:
P. PATTERSON	S. SPANGLER	A3E2

SERIAL NO.	ODOMETER:	HOUR METER:	TEST ITEM CONDITION:
2207	146	81.4	COMBAT LOADED

TEMPERATURE:	HUMIDITY:	TEST SITE:	SURFACE:
18 DEGREES C	33%	PERRYMAN TEST COURSE	PAVED

TERRAIN:	BAROMETERIC PRESSURE:	SKY COVER:	WIND DIRECTION:
LEVEL	1013 MILLIBARS	PARTLY CLOUDLY	NORTH NORTHEAST

WIND SPEED:	TAPE RECORDER:	OCTAVE ANALYZER:	SOUND LEVEL METER:
5 KNOTS	B&K 7006	B&K 2131	

MICROPHONE:	STATIONARY OPERATION	HIGHWAY DRIVING	DRIVE-BY
B&K 4155	(X)	(X)	( )

INTERIOR	EXTERIOR	MICROPHONE LOCATION:
(X)	( )	RIGHT CANNONEERS SEAT

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							OCTAVE BAND CENTER FREQUENCIES (HZ)							
GEAR	RPM	SPEED KM/HR	dBA	dBB	dBC	ALL PASS	31.5	63	125	250	500	1000	2000	4000	8000
AMBIENT															
			58	57	58	65	44	50	47	43	45	52	48	50	54
HATCHES OPEN; NO EQUIPMENT ON															
N	800		85	87	89	90	67	77	82	82	84	81	71	62	61
HATCHES OPEN; VENT BLOWER ON "INTAKE"															
N	800		96	96	96	97	66	81	83	82	89	94	87	73	64
HATCHES OPEN; MCS ON "COOL"															
N	800		91	93	94	94	66	81	81	84	92	84	80	71	66
HATCHES OPEN; MCS ON "COOL"; VENT BLOWER ON "INTAKE"; HYDRAULICS ON															
N	800		97	98	98	99	74	85	90	85	93	95	88	78	71
HATCHES OPEN; MCS ON "COOL"; VENT BLOWER ON "INTAKE"															
D		5	97	99	100	100	77	91	91	93	94	94	88	77	72
D		10	99	101	102	102	87	94	91	94	97	95	89	82	80
D		15	102*	105	107	107	97	100	96	101	101	95	92	83	80
D		20	105*	108	110	110	96	104	99	104*	105*	99	95	85	81
D		25	111*	113	115	116	105	108	103	108*	110*	106*	102*	93	90
D		30	110*	114	115	116	91	109	103	110*	110*	105*	100	90	82
D		35	111*	114	116	117	93	113	105	110*	110*	105*	101*	94	91
MAXIMUM ALLOWABLE LIMITS OF MIL-STD-1474B(MI), TABLE 2, CATEGORY B															
			100				121	111	103	102	100	100	100	100	

*LEVELS EXCEEDING MAXIMUM ALLOWABLE LIMITS OF CATEGORY B

ACOUSTICAL TEST DATA

TIME: 1300	DATE: 28 APRIL 89	TEST ITEM: M109 (HIP) HOWITZER	
TEST CONDUCTED BY: P. PATTERSON	TEST ITEM OPERATOR: S. SPANGLER	REG./MODEL NO: A3E2	
SERIAL NO. 2207	ODOMETER: 146	HOUR METER: 81.4	TEST ITEM CONDITION: COMBAT LOADED
TEMPERATURE: 18 DEGREES C	HUMIDITY: 33%	TEST SITE: PERRYMAN TEST COURSE	SURFACE: PAVED
TERRAIN: LEVEL	BAROMETERIC PRESSURE: 1013 MILLIBARS	SKY COVER: PARTLY CLOUDLY	WIND DIRECTION: NORTH NORTHEAST
WIND SPEED: 5 KNOTS	TAPE RECORDER: B&K 7006	OCTAVE ANALYZER: B&K 2131	SOUND LEVEL METER:
MICROPHONE: B&K 4155	STATIONARY OPERATION (X)	HIGHWAY DRIVING (X)	DRIVE-BY ( )
INTERIOR (X)	EXTERIOR ( )	MICROPHONE LOCATION: COMMANDER'S POSITION	

							OCTAVE BAND CENTER FREQUENCIES (HZ)							
GEAR	RPM	SPEED KM/HR	dBA	dBB	dBC	ALL PASS	31.5	63	125	250	500	1000	2000	4000	8000
AMBIENT															
N			57	58	61	65	52	55	56	45	45	50	48	50	53
HATCHES OPEN; NO EQUIPMENT ON															
N	800		86	92	95	95	74	83	94	85	84	82	74	70	70
HATCHES OPEN; VENT BLOWER ON "INTAKE"															
N	800		94	96	98	98	74	83	94	84	87	92	88	77	70
HATCHES OPEN; MCS ON "COOL"															
N	800		94	97	98	99	75	89	92	86	95	86	86	78	70
HATCHES OPEN; MCS ON "COOL"; VENT BLOWER ON "INTAKE"; HYDRAULICS ON															
N	800		98	99	101	101	82	92	94	89	94	95	90	82	80
HATCHES OPEN; MCS ON "COOL"; VENT BLOWER ON "INTAKE"															
D		5	98	100	102	102	88	95	94	94	96	94	90	82	80
D		10	101*	104	107	107	94	100	103	98	98	95	92	90	90
D		15	103*	107	111	113	107	107	105	103	102	97	94	90	90
D		20	106*	111	114	114	99	109	108	106*	106*	100	97	90	90
D		25	109*	112	114	115	103	107	109	106*	108*	104*	101*	96	90
D		30	111*	115	118	118	97	112	112*	111*	111*	105*	101*	94	90
D		35	112*	116	119	120	101	116	112*	112*	111*	106*	103*	100	100
MAXIMUM ALLOWABLE LIMITS OF MIL-STD-1474B (PARA 2, CATEGORY B)															
		100					121	111	111	102	100	100	100	100	100

*LEVELS EXCEEDING MAXIMUM ALLOWABLE LIMITS OF CATEGORY B

IMPULSE NOISE LEVELS OF THE M109A2 HELP HOWITZER

	Crew Positions				
Round 1	Commander	Driver	Gunner	Loader	Assistant Gunner
Peak (dB)	146	162	157	158	161
B Duration (msec)	200	172.9	200	194.6	196.1
Single[a]	1000	1000	1000	1000	1000
Double[b]	1000	1000	1000	1000	1000
Round 2					
Peak (dB)	148	162	160	157	160
B Duration (msec)	200	173.6	200	200	200
Single[a]	1000	1000	1000	1000	1000
Double[b]	1000	1000	1000	1000	1000
Round 3					
Peak (dB)	149	162	162	160	162
B Duration (msec)	200	118.1	200	200	200
Single[a]	1000	1000	1000	1000	1000
Double[b]	1000	1000	1000	1000	1000
Round 4					
Peak (dB)	149	162	160	158	161
B Duration (msec)	200	158	200	200	200
Single[a]	1000	1000	1000	1000	1000
Double[b]	1000	1000	1000	1000	1000
Round 5 Peak (dB)					
Peak (dB)	149	163	161	158	162
B Duration (msec)	200	126	200	200	200
Single[a]	1000	1000	1000	1000	1000
Double[b]	1000	1000	1000	1000	1000

[a] Single hearing protection.
[b] Double hearing protection.

ACOUSTICAL TEST DATA

TIME:	DATE:	TEST ITEM:
1350	26 AUGUST 86	LIGHT ARMOR VEHICLE

TEST CONDUCTED BY:	TEST ITEM OPERATOR:	REG./MODEL NO:
R. MOODY JR	SP-4 REECE	LAV-25

SERIAL NO.	ODOMETER:	HOUR METER:	TEST ITEM CONDITION:
USMC 511706	995	43.4	FULL PAYLOAD

TEMPERATURE:	HUMIDITY:	TEST SITE:	SURFACE:
36 DEG C	37%	YUMA PROVING GROUND	DIRT

TERRAIN:	BAROMETERIC PRESSURE:	SKY COVER:	WIND DIRECTION:
FLAT	995.8 mbs		194 DEG

WIND VELOCITY:	TAPE RECORDER:	OCTAVE ANALYZER:	SOUND LEVEL METER:
4 KNOTS	B&K 7006	B&K 2131	

MICROPHONE:	STATIONARY OPERATION	HIGHWAY DRIVING	DRIVE-BY
B&K 4155	( )	(X)	( )

INTERIOR	EXTERIOR	MICROPHONE LOCATION:
(X)	( )	DRIVER

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						OCTAVE BAND CENTER FREQUENCIES (HZ)								
GEAR	RPM	SPEED KM/HR	dBA	dBB	dBC	ALL PASS	31.5	63	125	250	500	1000	2000	4000	8000
					TURRET POSITION 0 DEG										
DR		10	97	100	104	106	102	96	98	92	91	93	91	85	74
DR		20	100	103	108	110	109	93	95	98	97	96	92	84	74
DR		40	99	101	106	109	105	97	98	95	92	96	93	86	74
DR		77	101*	105	109	114	108	98	103	101	97	96	94	85	75
					TURRET POSITION 90 DEG										
DR		10	97	100	103	106	101	96	97	95	90	93	92	81	73
DR		20	102*	103	106	108	105	96	92	96	95	96	98	84	80
DR		40	100	101	106	109	106	96	97	96	92	92	97	83	74
DR		77	102*	105	109	116	108	98	103	101	98	95	97	83	75
					TURRET POSITION 180 DEG										
DR		10	98	99	103	105	101	93	93	94	91	89	95	81	74
DR		20	101*	103	106	108	105	96	93	97	95	96	97	84	77
DR		40	98	101	106	109	106	97	97	96	93	91	93	82	74
DR		77	101*	105	109	113	108	98	102	101	99	94	95	83	75
					TURRET POSITION 270 DEG										
DR		10	99	102	106	108	104	100	100	94	94	94	94	83	76
DR		20	100	102	107	109	107	93	95	96	95	95	96	83	75
DR		40	100	102	106	109	105	97	99	96	96	94	95	85	77
DR		77	103*	106	110	114	108	98	104	100	101	96	98	84	77
						MAXIMUM ALLOWABLE LIMITS OF CATEGORY B. TABLE 2 OF MIL-STD-1474B(MI)										
		100					121	111	103	102	100	100	100	100	

*LEVELS EXCEEDING MAXIMUM ALLOWABLE LIMITS OF CATEGORY B

ACOUSTICAL TEST DATA

TIME:	DATE:	TEST ITEM:
1350	26 AUGUST 86	LIGHT ARMOR VEHICLE

TEST CONDUCTED BY:	TEST ITEM OPERATOR:	REG./MODEL NO:
R. MOODY JR	SP-4 REECE	LAV-25

SERIAL NO.	ODOMETER:	HOUR METER:	TEST ITEM CONDITION:
USMC 511706	1995	143.4	FULL PAYLOAD

TEMPERATURE:	HUMIDITY:	TEST SITE:	SURFACE:
36 DEG C	17%	YUMA PROVING GROUND	DIRT

TERRAIN:	BAROMETERIC PRESSURE:	SKY COVER:	WIND DIRECTION:
FLAT	1995.8 mbs		194 DEG

WIND VELOCITY:	TAPE RECORDER:	OCTAVE ANALYZER:	SOUND LEVEL METER:
4 KNOTS	B&K 7006	B&K 2131	

MICROPHONE:	STATIONARY OPERATION	HIGHWAY DRIVING	DRIVE-BY
B&K 4155	( )	(X)	( )

INTERIOR	EXTERIOR	MICROPHONE LOCATION:
( )	( )	GUNNER

						OCTAVE BAND CENTER FREQUENCIES (HZ)								
GEAR	RPM	SPEED KM/HR	dBA	dBB	dBC	ALL PASS	31.5	63	125	250	500	1000	2000	4000	8000
						TURRET POSITION 0 DEG									
DR		10	100	102	104	106	95	96	101	87	86	100	86	81	75
DR		20	98	99	102	104	99	96	89	88	89	96	89	84	75
DR		40	98	100	104	106	97	101	96	89	87	96	88	82	75
DR		77	97	100	104	113	100	101	98	93	90	95	87	83	75
						TURRET POSITION 90 DEG									
DR		10	96	98	102	104	94	99	96	91	90	89	91	80	74
DR		20	93	95	100	102	95	98	89	86	90	89	87	79	73
DR		40	95	98	103	106	99	100	95	90	89	90	91	79	74
DR		77	95	100	105	116	98	102	99	94	90	90	90	79	75
						TURRET POSITION 180 DEG									
DR		10	94	98	102	103	95	97	99	82	85	91	88	80	74
DR		20	94	95	100	102	96	97	90	83	85	88	90	79	74
DR		40	94	97	102	106	98	100	95	86	86	88	90	80	75
DR		77	95	99	105	112	99	103	99	91	87	90	91	81	75
						TURRET POSITION 270 DEG									
DR		10	94	97	102	104	95	100	96	86	85	90	89	82	74
DR		20	96	97	100	103	98	96	91	86	87	90	92	82	75
DR		40	94	97	102	106	97	99	96	86	86	89	90	81	75
DR		77	95	99	104	113	100	100	99	92	90	89	89	81	76
						MAXIMUM ALLOWABLE LIMITS OF CATEGORY B, TABLE 2 OF MIL-STD-1474B(MI)									
			100					121	111	103	102	100	100	100	100

ACOUSTICAL TEST DATA

TIME:	DATE:	TEST ITEM:
1350	26 AUGUST 86	LIGHT ARMOR VEHICLE

TEST CONDUCTED BY:	TEST ITEM OPERATOR:	REG./MODEL NO:
R. MOODY JR	SP-4 REECE	LAV-25

SERIAL NO.	ODOMETER:	HOUR METER:	TEST ITEM CONDITION:
USMC 511706	1995	143.4	FULL PAYLOAD

TEMPERATURE:	HUMIDITY:	TEST SITE:	SURFACE:
36 DEG C	17%	YUMA PROVING GROUND	DIRT

TERRAIN:	BAROMETERIC PRESSURE:	SKY COVER:	WIND DIRECTION:
FLAT	995.8 mbs		194 DEG

WIND VELOCITY:	TAPE RECORDER:	OCTAVE ANALYZER:	SOUND LEVEL METER:
4 KNOTS	B&K 7006	B&K 2131	

MICROPHONE:	STATIONARY OPERATION	HIGHWAY DRIVING	DRIVE-BY
B&K 4155	( )	(X)	( )

INTERIOR	EXTERIOR	MICROPHONE LOCATION:
(X)	( )	COMMANDER

						OCTAVE BAND CENTER FREQUENCIES (HZ)								
GEAR	RPM	SPEED KM/HR	dBA	dBB	dBC	ALL PASS	31.5	63	125	250	500	1000	2000	4000	8000
						TURRET POSITION 0 DEG									
DR		10	99	100	101	103	93	92	95	89	84	97	94	85	78
DR		20	100	100	101	103	96	91	88	89	86	99	92	84	77
DR		40	100	101	104	108	100	100	97	91	88	98	93	85	75
DR		77	101*	103	108	114	106	102	100	97	92	98	93	85	82
						TURRET POSITION 90 DEG									
DR		10	98	101	103	104	90	93	101	95	89	94	92	81	73
DR		20	98	99	100	101	92	93	86	93	89	96	91	83	73
DR		40	95	98	100	103	94	95	94	92	89	92	87	81	74
DR		77	96	99	102	112	94	97	96	96	91	92	90	81	75
						TURRET POSITION 180 DEG									
DR		10	98	99	101	102	90	93	95	85	87	96	92	79	74
DR		20	96	97	98	100	91	92	86	85	89	95	88	81	75
DR		40	96	97	100	103	93	96	93	86	88	94	88	80	74
DR		77	97	99	103	108	95	99	96	92	90	95	88	80	75
						TURRET POSITION 270 DEG									
DR		10	100	101	103	104	90	99	93	92	89	96	97	80	74
DR		20	100	101	102	103	92	93	87	93	89	96	97	80	75
DR		40	99	100	102	104	92	96	94	95	90	95	94	80	75
DR		77	98	101	103	110	96	98	96	96	92	94	93	82	75
						MAXIMUM ALLOWABLE LIMITS OF CATEGORY B, TABLE 2 OF MIL-STD-1474B(MI)									
			100				121	111	103	102	100	100	100	100	

*LEVELS EXCEEDING MAXIMUM ALLOWABLE LIMITS OF CATEGORY B

ACOUSTICAL TEST DATA

TIME: 1350	DATE: 26 AUGUST 86	TEST ITEM: LIGHT ARMOR VEHICLE	
TEST CONDUCTED BY: R. MOODY JR	TEST ITEM OPERATOR: SP-4 REECE	REG./MODEL NO: LAV-25	
SERIAL NO. USMC 511706	ODOMETER: 1995	HOUR METER: 143.4	TEST ITEM CONDITION: FULL PAYLOAD
TEMPERATURE: 36 DEG C	HUMIDITY: 32%	TEST SITE: YUMA PROVING GROUND	SURFACE: DIRT
TERRAIN: FLAT	BAROMETERIC PRESSURE: 995.8 mbs	SKY COVER:	WIND DIRECTION: 194 DEG
WIND VELOCITY: 4 KNOTS	TAPE RECORDER: B&K 7006	OCTAVE ANALYZER: B&K 2131	SOUND LEVEL METER:
MICROPHONE: B&K 4155	STATIONARY OPERATION ( )	HIGHWAY DRIVING (X)	DRIVE-BY ( )
INTERIOR ( )	EXTERIOR ( )	MICROPHONE LOCATION: LEFT CREWMEN (FORWARD)	

						OCTAVE BAND CENTER FREQUENCIES (HZ)								
GEAR	RPM	SPEED KM/HR	dBA	dBB	dBC	ALL PASS	31.5	63	125	250	500	1000	2000	4000	8000
						TURRET POSITION 0 DEG									
DR		10	99*	101	102	103	93	87	90	98*	89*	96*	93*	86*	77
DR		20	99*	100	102	103	98	91	85	95*	90*	96*	94*	85*	77
DR		40	99*	100	101	103	96	93	90	94*	90*	96*	92*	85*	76
DR		77	100*	102	104	107	99	95	98*	98*	92*	97*	94*	85*	76
						TURRET POSITION 90 DEG									
DR		10	101*	101	102	103	93	91	92	89	92*	96*	98*	86*	77
DR		20	100*	100	101	103	97	91	84	87	95*	93*	96*	87*	76
DR		40	100*	100	102	103	96	92	90	90*	94*	93*	97*	85*	77
DR		77	101*	102	104	108	97	95	97*	96*	95*	93*	97*	85*	77
						TURRET POSITION 180 DEG									
DR		10	101*	101	101	102	93	86	84	95*	88*	94*	98*	87*	80
DR		20	100*	100	102	103	97	90	85	94*	89*	96*	96*	86*	81
DR		40	99*	100	102	103	96	92	92	95*	89*	94*	94*	86*	81
DR		77	102*	102	104	107	99	95	95	97*	91*	95*	99*	85*	80
						TURRET POSITION 270 DEG									
DR		10	98*	99	101	102	94	92	90	93*	87*	93*	95*	82*	77
DR		20	97*	98	100	101	97	86	84	90*	89*	92*	94*	83*	77
DR		40	97*	98	100	102	95	91	89	90*	90*	90*	94*	83*	77
DR		77	98*	100	102	107	99	94	95	96*	92*	92*	93*	83*	77
						MAXIMUM ALLOWABLE LIMITS OF CATEGORY D, TABLE 2 OF MIL-STD-1474B(MI)									
			<85				106	96	89	83	80	79	79	81	

*LEVELS EXCEEDING MAXIMUM ALLOWABLE LIMITS OF CATEGORY D

ACOUSTICAL TEST DATA

TIME:	DATE:	TEST ITEM:	
1350	26 AUGUST 86	LIGHT ARMOR VEHICLE	
TEST CONDUCTED BY:	TEST ITEM OPERATOR:	REG./MODEL NO:	
R. MOODY JR	SP-4 REECE	LAV-25	
SERIAL NO.	ODOMETER:	HOUR METER:	TEST ITEM CONDITION:
USMC 511706	1995	143.4	FULL PAYLOAD
TEMPERATURE:	HUMIDITY:	TEST SITE:	SURFACE:
36 DEG C	13%	YUMA PROVING GROUND	DIRT
TERRAIN:	BAROMETERIC PRESSURE:	SKY COVER:	WIND DIRECTION:
FLAT	1995.8 mbs		194 DEG
WIND VELOCITY:	TAPE RECORDER:	OCTAVE ANALYZER:	SOUND LEVEL METER:
4 KNOTS	B&K 7006	B&K 2131	
MICROPHONE:	STATIONARY OPERATION ( )	HIGHWAY DRIVING (X)	DRIVE-BY ( )
B&K 4155			
INTERIOR EXTERIOR	MICROPHONE LOCATION: RIGHT CREWMEN (FORWARD)		

							OCTAVE BAND CENTER FREQUENCIES (HZ)							
GEAR	RPM	SPEED KM/HR	dBA	dBB	dBC	ALL PASS	31.5	63	125	250	500	1000	2000	4000	8000
						TURRET POSITION 0 DEG								
DR		10	107*	107	108	108	96	95	88	90*	88*	107*	93*	83*	75
DR		20	102*	102	103	105	99	93	86	88	88*	101*	95*	83*	75
DR		40	104*	104	105	106	99	93	90	91*	90*	103*	94*	86*	76
DR		77	105*	105	106	110	100	94	93	98*	92*	101*	100*	86*	76
						TURRET POSITION 90 DEG								
DR		10	100*	100	102	103	96	93	95	91*	89*	93*	97*	84*	78
DR		20	100*	100	101	103	98	90	85	89	90*	93*	97*	85*	79
DR		40	101*	101	102	104	99	92	89	91*	91*	95*	98*	84*	79
DR		77	100*	102	104	111	100	94	94	98*	94*	95*	96*	84*	80
						TURRET POSITION 180 DEG								
DR		10	98*	99	101	103	96	87	94	91*	89*	94*	93*	85*	79
DR		20	98*	98	101	104	99	90	92	91*	90*	93*	93*	85*	78
DR		40	97*	98	101	104	99	91	89	92*	90*	92*	93*	84*	79
DR		77	100*	102	104	107	100	94	96	99*	94*	93*	96*	84*	79
						TURRET POSITION 270 DEG								
DR		10	100*	101	103	104	95	92	97*	94*	90*	95*	96*	83*	76
DR		20	100*	100	102	104	100	89	84	95*	92*	93*	97*	82*	76
DR		40	101*	101	103	105	99	92	90	94*	91*	95*	98*	84*	76
DR		77	101*	103	105	110	100	94	95	98*	94*	95*	98*	83*	77
						MAXIMUM ALLOWABLE LIMITS OF CATEGORY D, TABLE 2 OF MIL-STD-1474B(MI)								
		<85					106	96	89	83	80	79	79	81

*LEVELS EXCEEDING MAXIMUM ALLOWABLE LIMITS OF CATEGORY D

ACOUSTICAL TEST DATA

TIME:	DATE:	TEST ITEM:
1350	26 AUGUST 86	LIGHT ARMOR VEHICLE

TEST CONDUCTED BY:	TEST ITEM OPERATOR:	REG./MODEL NO:
[illegible] MOODY JR	SP-4 REECE	LAV-25

SERIAL NO.	ODOMETER:	HOUR METER:	TEST ITEM CONDITION:
USMC 511706	1995	143.4	FULL PAYLOAD

TEMPERATURE:	HUMIDITY:	TEST SITE:	SURFACE:
36 DEG C	17%	YUMA PROVING GROUND	DIRT

TERRAIN:	BAROMETERIC PRESSURE:	SKY COVER:	WIND DIRECTION:
FLAT	995.8 mbs		194 DEG

WIND VELOCITY:	TAPE RECORDER:	OCTAVE ANALYZER:	SOUND LEVEL METER:
4 KNOTS	B&K 7006	B&K 2131	

MICROPHONE:	STATIONARY OPERATION	HIGHWAY DRIVING	DRIVE-BY
B&K 4155	( )	(X)	( )

INTERIOR ( ) EXTERIOR ( ) MICROPHONE LOCATION: [illegible]

							OCTAVE BAND CENTER FREQUENCIES (HZ)							
GEAR	RPM	SPEED KM/HR	dBA	dBB	dBC	ALL PASS	31.5	63	125	250	500	1000	2000	4000	8000
TURRET POSITON 0 DEG															
DR		10	97*	99	105	106	98	104	90	88	90*	94*	93*	84*	75
DR		20	96*	97	102	105	102	98	88	90*	88*	90*	91*	86*	74
DR		40	98*	99	104	106	102	101	92	89	92*	92*	94*	85*	75
DR		77	99*	101	105	110	103	101	95	93*	93*	94*	95*	84*	76
TURRET POSITION 90 DEG															
DR		10	97*	99	103	105	99	100	96	86	89*	93*	92*	84*	79
DR		20	96*	97	102	104	101	96	86	87	89*	93*	91*	84*	78
DR		40	98*	99	104	106	102	100	90	88	89*	93*	94*	85*	79
DR		77	98*	100	105	113	103	101	96	95*	92*	91*	94*	84*	78
TURRET POSITION 180 DEG															
DR		10	100*	100	103	105	98	95	95	87	86*	91*	98*	87*	78
DR		20	101*	100	103	106	101	96	93	87	87*	91*	99*	86*	78
DR		40	101*	101	104	106	102	99	90	88	88*	92*	98*	87*	78
DR		77	101*	102	106	109	103	102	96	96*	93*	92*	99*	85*	77
TURRET POSITION 270 DEG															
DR		10	97*	99	102	104	98	96	98*	84	88*	89*	94*	83*	75
DR		20	97*	98	102	105	103	96	86	84	89*	93*	93*	83*	75
DR		40	99*	100	104	107	101	101	90	87	90*	94*	96*	83*	76
DR		77	101*	102	106	111	103	101	97*	92*	93*	93*	98*	86*	76
MAXIMUM ALLOWABLE LIMITS OF CATEGORY D, TABLE 2 OF MIL-STD-1474B(MI)															
		<85					106	96	89	83	80	79	79	81	

*LEVELS EXCEEDING MAXIMUM ALLOWABLE LIMITS OF CATEGORY D

ACOUSTICAL TEST DATA

TIME:	DATE:	TEST ITEM:
1100	27 APR 89	M9 ACE

TEST CONDUCTED BY:	TEST ITEM OPERATOR:	REG./MODEL NO:
K.DICKHOFF	ROBERT PARKER	

SERIAL NO.	ODOMETER:	HOUR METER:	TEST ITEM CONDITION:
A038	589	273.9	DRIVING

TEMPERATURE:	HUMIDITY:	TEST SITE:	SURFACE:
66 DEG F	42%	PERRYMAN	ASPHALT

TERRAIN:	BAROMETERIC PRESSURE:	SKY COVER:	WIND DIRECTION:
FLAT	1011.7 mb	CLEAR	N 005 DEG

WIND SPEED:	TAPE RECORDER:	OCTAVE ANALYZER:	SOUND LEVEL METER:
3 km/hr	7006	2131	N/A

MICROPHONE:	STATIONARY OPERATION	HIGHWAY DRIVING	DRIVE-BY
4155	(X)	( )	( )

INTERIOR	EXTERIOR	MICROPHONE LOCATION:
(X)	( )	DRIVER

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						OCTAVE BAND CENTER FREQUENCIES (HZ)									
GEAR	RPM	SPEED KM/HR	dBA	dBB	dBC	ALL PASS	31.5	63	125	250	500	1000	2000	4000	8000
						HATCH OPEN/FAN OFF									
N	800	0	83	88	93	95	92	88	84	83	82	79	73	63	62
N	1800	0	98	101	105	107	102	102	91	97	97	93	88	77	69
						HATCH OPEN/FAN ON									
N	800	0	93	94	96	98	93	90	84	89	84	84	87	88	80
N	1800	0	99	101	105	106	101	100	92	96	97	94	90	89	80
						HATCH CLOSED/FAN OFF									
N	800	0	85	92	102	106	105	93	89	86	83	81	75	67	67
N	1800	0	99	103	110	113	111	102	97	100	98	93	87	79	72
						HATCH CLOSED/FAN ON									
N	800	0	98	99	102	104	102	92	89	94	88	93	92	92	87
N	1800	0	101*	104	110	112	110	103	99	99	98	95	91	92	86
						MAXIMUM ALLOWABLE LIMITS OF MIL-STD-1474B(MI), TABLE 2, CATEGORY B									
			100				121	111	103	102	100	100	100	100	

*LEVELS EXCEEDING MAXIMUM ALLOWABLE LIMITS OF CATEGORY B

ACOUSTICAL TEST DATA

TIME:	DATE:	TEST ITEM:
1100	27 APR 89	M9 ACE

TEST CONDUCTED BY:	TEST ITEM OPERATOR:	REG./MODEL NO:
K.DICKHOFF	ROBERT PARKER	

SERIAL NO.	ODOMETER:	HOUR METER:	TEST ITEM CONDITION:
A038	589	273.9	DRIVING

TEMPERATURE:	HUMIDITY:	TEST SITE:	SURFACE:
66 DEG F	42%	PERRYMAN	ASPHALT

TERRAIN:	BAROMETERIC PRESSURE:	SKY COVER:	WIND DIRECTION:
FLAT	1011.7 mb	CLEAR	N 005 DEG

WIND SPEED:	TAPE RECORDER:	OCTAVE ANALYZER:	SOUND LEVEL METER:
3 km/hr	7006	2131	N/A

MICROPHONE:	STATIONARY OPERATION	HIGHWAY DRIVING	DRIVE-BY
4155	(X)	(X)	( )

INTERIOR	EXTERIOR	MICROPHONE LOCATION:
(X)	( )	DRIVER

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							OCTAVE BAND CENTER FREQUENCIES (HZ)							
GEAR	RPM	SPEED KM/HR	dBA	dBB	dBC	ALL PASS	31.5	63	125	250	500	1000	2000	4000	8000
HATCH OPEN/FAN ON															
1	1800	3.9	99	102	105	106	101	100	92	97	98	94	91	86	81
2	1800	6.1	99	102	104	106	100	98	93	97	97	94	90	86	80
3	1800	9.7	99	102	104	106	100	98	94	97	97	94	91	86	80
4	1800	14.4	100	103	106	107	102	100	95	98	96	95	91	87	80
5	1800	21.4	102*	105	108	110	104	103	99	101	100	98	92	87	80
6	1800	24.8	104*	107	110	111	104	105	100	102	100	100	94	87	80
HATCH OPEN/FAN OFF															
1	1800	3.9	98	102	105	107	102	102	91	98	96	93	89	74	70
2	1800	6.2	98	102	104	107	100	100	92	98	97	93	88	74	69
3	1800	9.5	98	102	104	107	101	100	93	98	97	93	89	74	69
4	1800	14.3	99	103	106	108	103	102	94	99	98	94	89	75	69
5	1800	21.5	101*	105	108	111	105	105	98	102	100	97	90	75	69
6	1800	24.7	103*	107	110	112	105	107	99	103	100	99	92	75	69
MAXIMUM ALLOWABLE LIMITS OF MIL-STD-1474B(MI), TABLE 2, CATEGORY B															
			100				121	111	103	102	100	100	100	100	

*LEVELS EXCEEDING MAXIMUM ALLOWABLE LIMITS OF CATEGORY B

DATA SHEET - ACOUSTICAL TEST DATA (SOP 73-1)

ACOUSTICAL TEST DATA

TIME: 1300	DATE: 7 SEPT 1982		
TEST ITEM: MULTIPLE LAUNCH ROCKET SYSTEM	TEST CONDUCTED BY: WM. H. DIEGEL	TEST ITEM OPERATOR: F. BALDWIN	
REG./MODEL NO:	SERIAL NO: 9	ODOMETER: / HOUR METER	TEST ITEM CONDITION: WINDOWS OPEN / FAN OFF / ESC NORMAL
TEMPERATURE: 77°F	HUMIDITY: 68%	TEST SITE: PERRYMAN A.P.G.	SURFACE: PAVED / TERRAIN: FLAT
BAROMETRIC PRESSURE: 1024.5	SKY COVER: OVERCAST	STATIONARY OPERATION ☐	HIWAY DRIVING ☒ / DRIVE-BY ☐
WIND DIRECTION: W.S.W	WIND VELOCITY: 3-6 mph	MICROPHONE: GR-1551-P1-150	SOUND LEVEL METER: GR-1551-C / OCTAVE ANALYZER: HP-5451-B
INTERIOR ☒ / EXTERIOR ☐	MICROPHONE LOCATION: AS SHOWN BELOW	TAPE RECORDER: NAGRA IV SJ	TAPE NO.: 1-MLRS

GEAR	RPM	APPROX SPEED	dbA	dbB	dbC	ALL PASS	31.5	63	125	250	500	1,000	2,000	4,000	8,000	REMARKS
							DRIVER									RUN # 1
D		10	106	112	119	120		113	113	105	102	100	95	89	85	
D		20	107	115	120	121		117	117	107	104	102	97	91	87	WINDOWS - OPEN
D		30	107	115	120	121		117	116	108	103	102	96	88	82	FAN - OFF
D		40	108	117	121	122		118	121	111	105	101	97	92	85	ESC - NORMAL
D	1750		103	118	124	125		124	116	108	104	102	98	90	86	
							GUNNER									
D		10	105	110	115	116		108	110	106	102	102	98	90	89	
D		20	108	114	116	117		107	115	108	105	103	99	93	90	
D		30	107	115	118	120		117	116	108	104	102	98	89	83	
D		40	109	118	121	121		106	118	114	107	103	100	93	88	
D	1750		107	119	119	120		117	112	108	103	101	98	92	90	
							COMMANDER									
D		10	106	114	120	121		117	113	107	101	100	96	92	88	
D		20	107	115	120	121		117	117	109	102	100	97	90	87	
D		30	108	117	122	123		123	114	110	100	100	97	87	82	
D		40	110	120	124	125		116	123	113	102	102	98	90	84	
D	1750		110	124	131	132		131	116	109	101	100	97	92	90	

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DATA SHEET - ACOUSTICAL TEST DATA (SOP 73-1)

ACOUSTICAL TEST DATA

TIME: 1300					DATE: 7 SEPT 1982
TEST ITEM: MULTIPLE LAUNCH ROCKET SYSTEM				TEST CONDUCTED BY: WM. H. DIEGEL	TEST ITEM OPERATOR: F. BALDWIN
REG./MODEL NO: 77° F	SERIAL NO: 9	ODOMETER:	HOUR METER	TEST ITEM CONDITION: WINDOWS OPEN / FAN LOW / ESC NORMAL	
TEMPERATURE: 77°F	HUMIDITY: 68%	TEST SITE: PERRYMAN A.P.G.		SURFACE: PAVED	TERRAIN: FLAT
BAROMETRIC PRESSURE: 1024.5	SKY COVER: OVERCAST	STATIONARY OPERATION ☐		HIWAY DRIVING ☒	DRIVE-BY ☐
WIND DIRECTION: W.S.W.	WIND VELOCITY: 3-6 mph	MICROPHONE: GR-1551-P1-150		SOUND LEVEL METER: GR-1551-C	OCTAVE ANALYZER: HP 5451-B
INTERIOR ☒ EXTERIOR ☐	MICROPHONE LOCATION: AS SHOWN BELOW			TAPE RECORDER: NAGRA IV SJ	TAPE NO.: 1 HLRS

GEAR	RPM	APPROX SPEED	dbA	dbB	dbC	ALL PASS	31.5	63	125	250	500	1,000	2,000	4,000	8,000	REMARKS
							DRIVER									RUN # 2
D		10	106	113	120	122		113	114	104	103	101	95	90	87	
D		20	107	115	120	121		115	117	106	104	102	97	91	86	WINDOWS - OPEN
D		30	106	115	120	120		115	118	108	102	100	95	88	81	FAN - LOW
D		40	108	117	121	121		109	120	112	105	101	97	92	84	ESC - NORMAL
D	1750		108	118	124	124		123	117	108	103	102	97	90	86	
							GUNNER									
D		10	105	110	116	117		108	110	106	101	101	97	89	89	
D		20	105	112	115	116		106	114	106	102	100	96	92	89	
D		30	106	113	117	118		111	116	107	102	101	97	89	82	
D		40	109	116	120	120		104	118	113	106	103	99	93	87	
D	1750		105	112	118	118		116	111	107	101	100	97	91	89	
							COMMANDER									
D		10	106	113	120	121		117	112	106	101	101	96	91	88	
D		20	107	115	120	121		114	118	110	102	101	98	91	89	
D		30	108	119	124	125		123	118	110	103	100	97	85	81	
D		40	110	119	124	124		115	123	113	104	102	97	89	83	
D	1750		111	123	131	132		130	117	108	102	101	98	93	90	

DATA SHEET - ACOUSTICAL TEST DATA (SOP 73-1)

ACOUSTICAL TEST DATA

TIME: 1300 | DATE: 7 SEPT 1982

TEST ITEM: MULTIPLE LAUNCH ROCKET SYSTEM

TEST CONDUCTED BY: WM H. DIEGEL | TEST ITEM OPERATOR: F. BALDWIN

REG./MODEL NO: | SERIAL NO: 9 | ODOMETER: | HOUR METER | TEST ITEM CONDITION: WINDOWS OPEN/FAN MEDIUM/ESC NORMAL

TEMPERATURE: 77°F | HUMIDITY: 68% | TEST SITE: PERRYMAN A.P.G. | SURFACE: PAVED | TERRAIN: FLAT

BAROMETRIC PRESSURE: 1024.5 | SKY COVER: OVERCAST | STATIONARY OPERATION ☑ | HIWAY DRIVING ☒ | DRIVE-BY ☐

WIND DIRECTION: W.S.W. | WIND VELOCITY: 3-6 mph | MICROPHONE: GR-1551-P1-150 | SOUND LEVEL METER: GR-1551-C | OCTAVE ANALYZER: HP-5451-B

INTERIOR ☒ EXTERIOR ☐ | MICROPHONE LOCATION: AS SHOWN BELOW | TAPE RECORDER: NAGRA IV SJ | TAPE NO.: 1 MLRS

GEAR	RPM	APPROX SPEED	dbA	dbB	dbC	ALL PASS	31.5	63	125	250	500	1,000	2,000	4,000	8,000	REMARKS
							DRIVER									RUN # 3
D		10	106	112	118	120		112	113	104	103	100	96	89	84	
D		20	108	116	121	122		118	118	108	105	103	98	91	88	WINDOWS - OPEN
D		30	106	115	120	120		117	116	108	104	100	96	85	81	FAN - MEDIUM
D		40	109	118	122	123		110	122	113	106	102	98	90	84	ESC - NORMAL
D	1750		108	117	123	124		123	115	107	105	102	98	89	86	
							GUNNER									
D		10	106	110	115	116		109	110	105	102	103	98	92	88	
D		20	108	114	117	118		107	116	108	106	103	100	94	91	
D		30	107	115	119	120		116	115	110	104	101	98	88	84	
D		40	109	117	120	120		106	118	114	107	103	101	93	88	
D	1750		108	114	119	120		117	113	110	105	101	99	93	90	
							COMMANDER									
D		10	105	113	119	120		116	113	106	101	99	95	92	88	
D		20	106	115	119	120		116	117	108	101	99	97	89	86	
D		30	109	119	124	125		122	121	111	103	101	98	87	81	
D		40	110	120	124	125		116	123	112	109	103	98	90	85	
D	1750		111	125	132	133		132	115	110	102	101	97	88	87	

(TOAI-III Form 2B ...)

DATA SHEET - ACOUSTICAL TEST DATA (SOP 73-1)

ACOUSTICAL TEST DATA

TIME: 1300 | DATE: 7 SEPT 1982

TEST ITEM: MULTIPLE LAUNCH ROCKET SYSTEM | TEST CONDUCTED BY: Wm H. DIEGEL | TEST ITEM OPERATOR: F. BALDWIN

REG./MODEL NO: | SERIAL NO: 9 | ODOMETER: | HOUR METER | TEST ITEM CONDITION: WINDOWS OPEN / FAN HIGH / ESC NORMAL

TEMPERATURE: 77°F | HUMIDITY: 68% | TEST SITE: PERRYMAN A.P.G. | SURFACE: PAVED | TERRAIN: FLAT

BAROMETRIC PRESSURE: 1024.5 | SKY COVER: OVERCAST | STATIONARY OPERATION ☐ | HIWAY DRIVING ☒ | DRIVE-BY ☐

WIND DIRECTION: W.S.W | WIND VELOCITY: 3-6 mph | MICROPHONE: GR-1551-P1-150 | SOUND LEVEL METER: GR-1551-C | OCTAVE ANALYZER: HP 5451-B

INTERIOR ☒ | EXTERIOR ☐ | MICROPHONE LOCATION: AS SHOWN BELOW | TAPE RECORDER: NAGRA IV SJ | TAPE NO.: 1 MLRS

GEAR	RPM	APPROX SPEED	dbA	dbB	dbC	ALL PASS	31.5	63	125	250	500	1,000	2,000	4,000	8,000	REMARKS
									DRIVER							RUN # 4
D		10	105	112	119	121		114	112	105	102	99	95	88	86	
D		20	108	116	121	122		118	118	107	105	102	97	91	88	WINDOWS - OPEN
D		30	107	116	121	121		117	118	108	102	101	96	87	83	FAN - HIGH
D		40	108	117	121	122		109	121	110	105	102	97	91	85	ESC - NORMAL
D	1750		109	119	125	126		125	117	107	104	102	98	90	86	
									GUNNER							
D		10	106	111	116	117		107	110	106	103	103	98	92	90	
D		20	109	114	117	118		107	115	110	106	103	100	95	92	
D		30	108	116	121	121		118	117	109	105	102	99	92	85	
D		40	110	117	120	121		106	118	114	106	104	102	94	89	
D	1750		108	115	120	120		118	113	109	104	102	100	92	90	
									COMMANDER							
D		10	107	115	121	122		118	115	109	102	102	96	92	88	
D		20	107	115	120	121		117	116	110	102	100	95	89	84	
D		30	108	117	122	123		121	116	112	102	100	97	88	83	
D		40	110	120	125	125		116	124	114	105	101	97	90	83	
D	1750		110	123	131	132		131	116	111	103	100	98	91	90	

DATA SHEET - ACOUSTICAL TEST DATA (SOP 73-1)

ACOUSTICAL TEST DATA

TIME: 1300 | DATE: 7 SEPT 1982

TEST ITEM: MULTIPLE LAUNCH ROCKET SYSTEM | TEST CONDUCTED BY: WM. H. DIEGEL | TEST ITEM OPERATOR: F. BALDWIN

REG./MODEL NO: | SERIAL NO: 9 | ODOMETER: | HOUR METER: | TEST ITEM CONDITION: WINDOWS CLOSED/FAN OFF/ESC FIRING

TEMPERATURE: 77°F | HUMIDITY: 68% | TEST SITE: PERRYMAN A.P.G. | SURFACE: PAVED | TERRAIN: FLAT

BAROMETRIC PRESSURE: 1025.4 | SKY COVER: OVERCAST | STATIONARY OPERATION ☐ | HIWAY DRIVING ☒ | DRIVE-BY ☐

WIND DIRECTION: W.S.W | WIND VELOCITY: 3-6 mph | MICROPHONE: GR-1551-P1-150 | SOUND LEVEL METER: GR-1551-C | OCTAVE ANALYZER: HP-5451-B

INTERIOR ☒ | EXTERIOR ☐ | MICROPHONE LOCATION: AS SHOWN BELOW | TAPE RECORDER: NAGRA IV SJ | TAPE NO.: 1 MLRS

GEAR	RPM	APPROX SPEED	dbA	dbB	dbC	ALL PASS	31.5	63	125	250	500	1,000	2,000	4,000	8,000	REMARKS
									DRIVER							RUN # 5
D		10	106	112	119	121		113	112	106	104	101	96	91	87	
D		20	108	115	120	121		117	117	106	105	103	97	89	87	WINDOWS CLOSED
D		30	107	116	121	122		118	117	108	104	100	96	88	83	FAN - OFF
D		40	110	119	123	123		110	122	110	106	102	98	91	85	ESC - FIRING
D	1750		107	119	121	127		126	117	107	105	104	99	92	89	
									GUNNER							
D		10	106	111	116	117		108	110	107	103	102	97	93	90	
D		20	107	113	117	117		108	115	108	105	101	99	93	90	
D		30	108	115	120	120		118	116	108	106	103	98	92	86	
D		40	110	117	120	121		106	119	113	106	104	100	94	89	
D	1750		109	115	120	120		117	115	111	105	103	100	95	92	
									COMMANDER							
D		10	108	114	121	123		116	115	108	104	103	98	91	89	
D		20	106	115	121	122		119	117	107	102	100	97	89	89	
D		30	109	120	124	125		121	121	112	103	101	97	87	82	
D		40	110	119	124	124		116	123	113	105	102	98	90	82	
D	1750		110	115	122	123		120	116	111	103	101	99	90	85	

STEAP-MT Form 288, 20 Aug 73

DATA SHEET - ACOUSTICAL TEST DATA (SOP 73-1)

ACOUSTICAL TEST DATA

TIME: 1300	DATE: 7 SEPT 1982				
TEST ITEM: MULTIPLE LAUNCH ROCKET SYSTEM	TEST CONDUCTED BY: WM. H. DIEGEL	TEST ITEM OPERATOR: F. BALDWIN			
REG./MODEL NO:	SERIAL NO: 9	ODOMETER:	HOUR METER	TEST ITEM CONDITION: WINDOWS CLOSED/FAN-LOW/ESC FIRING	
TEMPERATURE: 77°F	HUMIDITY: 68%	TEST SITE: PERRYMAN A.P.G.	SURFACE: PAVED	TERRAIN: FLAT	
BAROMETRIC PRESSURE: 1024.5	SKY COVER: OVERCAST	STATIONARY OPERATION ☐	HIWAY DRIVING ☒	DRIVE-BY ☐	
WIND DIRECTION: W.S.W	WIND VELOCITY: 3-6 mph	MICROPHONE: GR-1551-P1-150	SOUND LEVEL METER: GR-1551-C	OCTAVE ANALYZER: HP-5451-B	
INTERIOR ☒ EXTERIOR ☐	MICROPHONE LOCATION: AS SHOWN BELOW	TAPE RECORDER: NAGRA IV-SJ	TAPE NO.: 1-MLRS		

GEAR	RPM	APPROX SPEED	dbA	dbB	dbC	ALL PASS	31.5	63	125	250	500	1,000	2,000	4,000	8,000	REMARKS
							DRIVER									RUN # 6
D		10	104	111	117	118		114	113	104	101	98	94	87	82	
D		20	110	118	125	125		124	116	108	107	105	100	92	90	WINDOWS - CLOSED
D		30	107	116	121	121		118	117	107	103	102	97	89	84	FAN - LOW
D		40	110	120	125	125		112	125	111	105	101	97	91	86	ESC - FIRING
D	1750		108	119	126	127		126	116	108	104	102	99	89	87	
							GUNNER									
D		10	104	109	113	114		108	109	105	100	100	95	91	92	
D		20	108	115	119	119		112	117	108	105	103	100	93	92	
D		30	107	113	118	118		119	115	106	104	102	98	90	86	
D		40	108	116	120	120		103	119	109	105	101	99	93	86	
D	1750		105	112	116	117		114	112	106	103	100	97	91	90	
							COMMANDER									
D		10	105	114	120	121		119	113	107	101	98	93	88	86	
D		20	108	119	127	128		126	119	110	102	100	97	91	89	
D		30	110	120	124	125		122	120	116	105	99	96	89	82	
D		40	110	121	126	126		119	124	112	105	100	99	89	83	
D	1750		108	119	126	127		126	116	109	102	99	96	88	84	

DATA SHEET - ACOUSTICAL TEST DATA (SOP 73-1)

ACOUSTICAL TEST DATA

TIME: 1300	DATE: 7 SEPT 1982			
TEST ITEM: MULTIPLE LAUNCH ROCKET SYSTEM			TEST CONDUCTED BY: WM. H. DIEGEL	TEST ITEM OPERATOR: F. BALDWIN
REG./MODEL NO:	SERIAL NO: 9	ODOMETER: / HOUR METER	TEST ITEM CONDITION: WINDOWS CLOSED/FAN MED/ESC FIRING	
TEMPERATURE: 77°F	HUMIDITY: 68%	TEST SITE: PERRYMAN A.P.G.	SURFACE: PAVED	TERRAIN: FLAT
BAROMETRIC PRESSURE: 1024.5	SKY COVER: OVERCAST	STATIONARY OPERATION ☐	HIWAY DRIVING ☒	DRIVE-BY ☐
WIND DIRECTION: W. S.W	WIND VELOCITY: 3-6 mph	MICROPHONE: GR-1551-P1-150	SOUND LEVEL METER: GR-1551-C	OCTAVE ANALYZER: HP-5451-B
INTERIOR ☒	EXTERIOR ☐	MICROPHONE LOCATION: AS SHOWN BELOW	TAPE RECORDER: NAGRA IV SJ	TAPE NO.: 1-MLRS

GEAR	RPM	APPROX SPEED	dbA	dbB	dbC	ALL PASS	31.5	63	125	250	500	1,000	2,000	4,000	8,000	REMARKS
							— DRIVER									RUN # 7
D		10	105	113	119	119		117	112	105	103	99	93	88	85	
D		20	111	120	126	127		125	121	110	106	106	100	94	91	WINDOWS - CLOSED
D		30	107	115	120	120		117	116	108	104	101	98	90	84	FAN - MEDIUM
D		40	109	119	123	124		115	123	110	105	102	96	90	84	ESC - FIRING
D	1750		109	122	129	129		129	116	107	104	102	96	89	88	
							— GUNNER									
D		10	106	111	115	115		111	111	106	103	102	96	91	88	
D		20	109	116	120	120		113	118	109	105	104	101	94	92	
D		30	108	115	120	120		117	116	107	105	102	99	90	86	
D		40	109	116	120	121		111	119	109	107	104	100	95	88	
D	1750		108	114	119	119		117	113	109	104	102	100	92	91	
							— COMMANDER									
D		10	104	114	121	122		120	114	107	99	98	93	86	87	
D		20	106	117	124	125		123	119	108	100	98	95	88	83	
D		30	109	119	125	126		124	120	112	103	100	97	88	84	
D		40	110	121	126	126		120	124	112	104	101	97	88	82	
D	1750		111	124	131	132		132	116	111	103	101	99	93	91	

DATA SHEET - ACOUSTICAL TEST DATA (SOP 73-1)

ACOUSTICAL TEST DATA

TIME: 1300	DATE: 7 SEPT 1982		
TEST ITEM: MULTIPLE LAUNCH ROCKET SYSTEM	TEST CONDUCTED BY: WM. H. DIEGEL	TEST ITEM OPERATOR: F. BALDWIN	
REG./MODEL NO:	SERIAL NO: 9	ODOMETER: / HOUR METER	TEST ITEM CONDITION: WINDOWS CLOSED/FAN HIGH/ESC FIRING
TEMPERATURE: 77° F	HUMIDITY: 68%	TEST SITE: PERRYMAN A.P.G.	SURFACE: PAVED / TERRAIN: FLAT
BAROMETRIC PRESSURE: 1024.5	SKY COVER: OVERCAST	STATIONARY OPERATION ☐ / HIWAY DRIVING ☒ / DRIVE-BY ☐	
WIND DIRECTION: W. S. W.	WIND VELOCITY: 3-6 mph	MICROPHONE: GR-1551-P1-150	SOUND LEVEL METER: GR-1551-C / OCTAVE ANALYZER: HP 5451-B
INTERIOR ☒ / EXTERIOR ☐	MICROPHONE LOCATION: AS SHOWN BELOW	TAPE RECORDER: NAGRA IV SJ	TAPE NO.: 1-MLRS

GEAR	RPM	APPROX SPEED	dbA	dbB	dbC	ALL PASS	31.5	63	125	250	500	1,000	2,000	4,000	8,000	REMARKS
								DRIVER								RUN # 8
D		10	105	113	120	120		117	113	106	101	99	94	88	86	
D		20	108	119	125	126		125	117	107	104	101	99	90	89	WINDOWS CLOSED
D		30	106	116	120	121		117	118	107	103	98	97	90	85	FAN - HIGH
D		40	108	117	122	122		115	120	110	105	101	97	91	85	ESC - FIRING
D	1750		108	119	126	127		126	114	109	103	103	95	90	88	
								GUNNER								
D		10	105	109	114	115		107	108	105	103	100	96	91	87	
D		20	108	114	118	118		110	116	109	105	103	99	95	94	
D		30	107	115	118	119		112	116	109	106	101	98	91	87	
D		40	108	114	117	117		104	115	112	106	102	99	92	87	
D	1750		108	113	116	117		109	114	109	105	102	100	92	94	
								COMMANDER								
D		10	106	116	123	124		123	113	108	102	96	93	89	87	
D		20	109	119	127	128		127	119	110	103	103	99	93	92	
D		30	110	121	126	127		125	121	113	104	101	100	87	83	
D		40	111	121	126	126		121	124	114	106	101	97	89	84	
D	1750		110	122	129	130		129	117	113	103	101	98	92	92	

2. IMPULSE NOISE TEST OF M901A2 (ITV)

2. .1 Objective

The objective was to evaluate the sound pressure levels to which crew members of the M901A1 (ITV) and personnel operating around the vehicles will be exposed to while firing the TOW 2 missile.

2. .2 Criteria

None were supplied; therefore, MIL-STD-1474B(MI) (Noise Limits for Army Materiel) was used to evaluate hearing protection requirements.

2. .3 Data Acquisition Procedure

This impulse noise test was conducted in accordance with TECOM TOP 1-2-608 (Sound Level Measurements) and MIL-STD-1474B(MI) (Noise Limits for Army Materiel) at a site free of all sound-reflecting surfaces within a 50-meter radius around the vehicle. A list of test instrumentation is presented in Table B-1 of the Appendix.

Impulse noise measurements of five TOW 2 rocket motors (slug warheads) were made at all interior crew stations and at four positions outside the vehicle.

Microphones were mounted with the sensing elements up, along a plane parallel to the ground at a height of 0.8m above the seats of each crew station. Tripod-mounted sound level meters were mounted at the exterior positions with the sensing elements facing up, along a plane parallel to the ground, 1.5m above ground.

System alignment and individual data channel (microphone-preamplifier) pistonphone calibrations were conducted both prior to testing and upon test completion. Sound pressure levels were recorded for five single TOW 2 missiles (rocket motors and slug).

2. .4 Results

Peak sound pressure levels for each position are presented in Table 2. .-1 and Table 2. .-2. Microphone accuracy is ±2 decibels(dB).

TABLE 2. .-1. IMPULSE NOISE LEVELS (INTERIOR)

Round No.:	1		2		3		4		5	
	"B"		"B"		"B"		"B"		"B"	
Position	Peak (dB)	Duration (msec)	Peak (dB)	Duration (msec)	Peak (dB)	Duration (msec)	Peak (dB)	Duration (msec)	Peak (dB)	Duration (msec)
Driver	—	——	—	——	151	>200	150	>200	156	196
Squad Leader	—	——	136	>200	137	194	138	196	140	>200
Gunner	—	——	153	181	159	134	158	>200	159	>200
Loader 1	—	——	152	>200	154	>200	153	>200	154	>200
Loader 2	—	——	152	>200	155	>200	155	>200	154	>200

2.4 RESULTS

Impulse noise levels at each position are presented in Table 2.4. Microphone accuracy is ±2 decibels (dB).

TABLE 2.4. FAASV IMPULSE NOISE (INTERIOR)

Crew Position:	1		2		3		4		5	
Round No.	Peak[a]	Mode	Peak	Mode	Peak	Mode	Peak	Mode	Peak	Mode
1	151	1	[b]164	1	158	1	148	1	147	1
2	151	2	[b]---	2	149	2	146	2	146	2
3	155	1	---	1	163	1	156	1	156	1
4	159	1	159	1	153	1	154	1	---	1

[a]Peak values are in dB; "B"-Duration for all rounds exceeded 200 msec.

[b]Data lost in acquisition.

Enviromental Conditions:
Temp- 22 °C
Humidity- 54%
Pressure- 1016.4 mb
Wind Speed- 6 km/hr

2.5 ANALYSIS

Analysis of this impulse noise data is difficult because only four FAASV AFES activations were measured. This is in variance with MIL-STD-1474B(MI), para 5.4.2.1.3, which states not only that a minimum of three samples be measured, but also that the spread of peak pressure levels (PPL's) in decibels (dB) not exceed the number of samples.

The worst-case PPL was 164 dB and was measured at crew position 2; the lowest PPL was 146 dB and was measured at crew position 5.

Despite the limited sample size, the impulse noise levels generated by FAASV AFES activations were above 140 dB (the minimum level for single hearing protection).

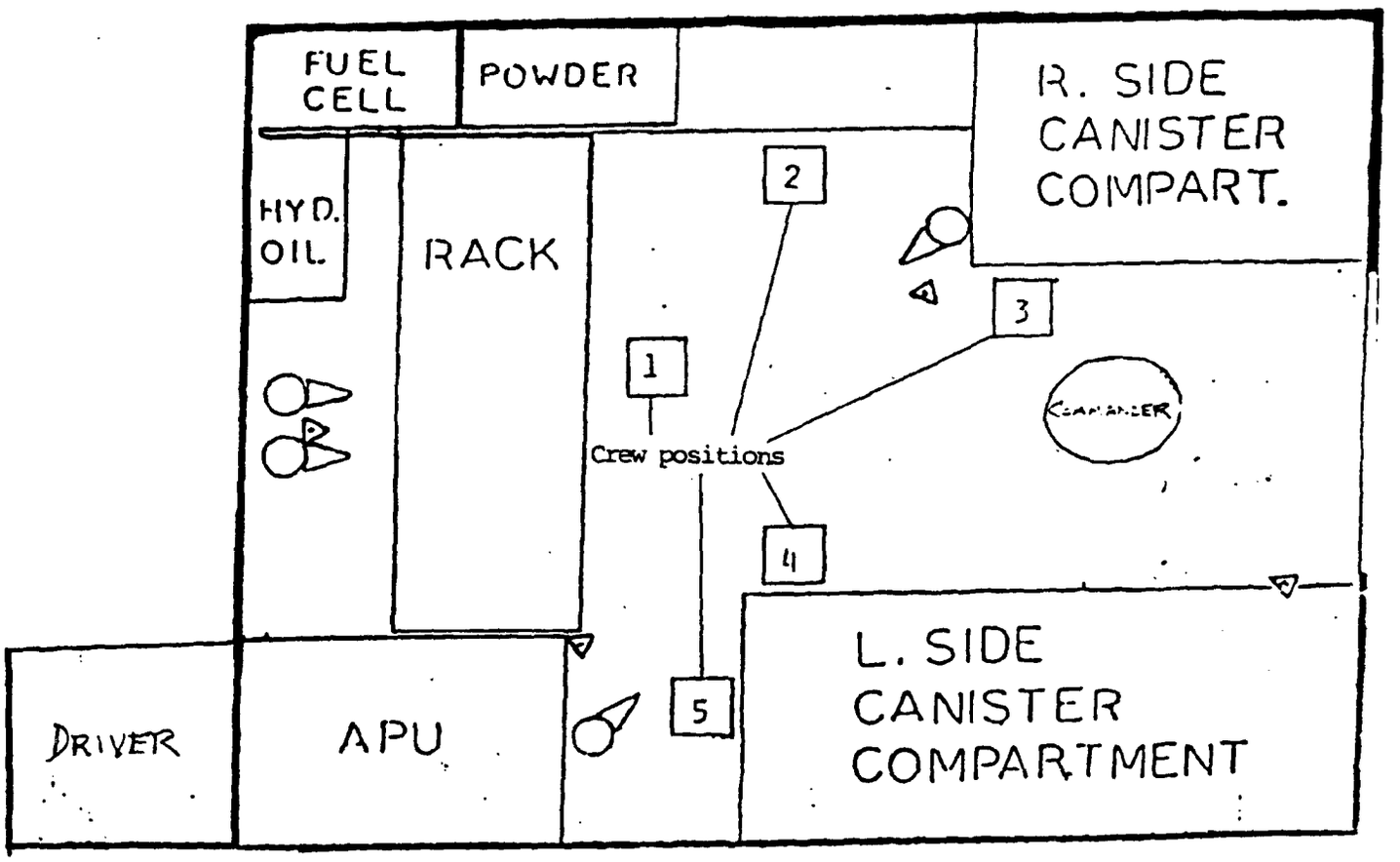
SECTION 3. CONCLUSIONS

Peak pressure levels produced during FAASV AFES activations indicate that single hearing protection must be worn by FAASV operators. No conclusions can be drawn as to whether double hearing protection is also required by the FAASV

APPENDIX

Table B-1

Crew Positions



APPENDIX D

HEAD INJURY INFORMATION FOR COMBAT VEHICLES CREWMAN FROM THE U.S. ARMY AEROMEDICAL RESEARCH LABORATORY

HEAD INJURY INFORMATION FOR COMBAT VEHICLES CREWMAN FROM
THE U.S. ARMY AEROMEDICAL RESEARCH LABORATORY

DEPARTMENT OF THE ARMY
U.S. ARMY AEROMEDICAL RESEARCH LABORATORY
FORT RUCKER, ALABAMA 36362-5292

REPLY TO ATTENTION OF:

SGRD-UAD-IE (70-45a) 14 August 1992

MEMORANDUM FOR Acting Director, U.S. Army Human Engineering Laboratory, ATTN: SLCHE-CC-LHD (CPT Oblak), Aberdeen Proving Ground, MD 21005-5001

SUBJECT: Head Injury Information for Combat Vehicle Crewman (CVC) Helmet

1. Reference memorandum, U.S. Army Aeromedical Research Laboratory, SGRD-UAD-IE, 26 May 92, SUBJECT: Request for Assistance in Collecting Head Injury Information.

2. As requested in referenced memorandum, this division has completed a study detailing injuries from the U.S. Army Safety Center (USASC) Database for head injury in vehicles where a CVC may be considered. The study was conducted by our staff epidemiologist, head injury specialists, and a student contractor.

3. As suspected, the injuries in the USASC database represent only severe mishaps and few cases involve injuries that involve little equipment damage or lost work days. I suggest that a survey of representative units be conducted to learn the incidence of injuries that may not appear in the USASC data. This may provide additional information on facial injury prevention and ballistic requirements.

4. Our study did indicate that some of these severe head injuries may have been prevented by providing additional impact protection as suggested in the summary report (Encl 1). Limitations in the information available from the USASC database did not allow us to predict the exact number of head injuries that could be prevented by helmet design changes.

5. We expect to publish a USAARL report detailing all of the procedures and details studied in this effort. This should be ready in the next 60 days and will be forwarded upon receipt from the printer. USAARL point of contact is Mr. Licina, DSN 558-6893 or Commercial (205) 255-6893.

Encl

JOHN V. BARSON
LTC, MC, SFS
Director, Biodynamics
Research Division

Injury Analysis: Head and Facial Injuries When Wearing the DH-132A Combat Vehicle Crewman Helmet

Troy A. Bowman
S.G. Shannon, Dr. Ph.

Introduction

On 11 May 1992, the U.S. Army Aeromedical Research Laboratory (USAARL) was tasked by the Human Engineering Laboratory (HEL) to conduct a study of head and facial injuries experienced by combat vehicle crewmen. The results of this study will be used to prepare design requirements for a new Combat Vehicle Crewman (CVC) helmet. The study included a search of the Army Safety Management Information System (ASMIS) database of the U.S. Army Safety Center, a review of several mishap reports, a survey of armored vehicles, and a search of the USAARL Aviation Life Support Retrieval Program (ALSERP) database.

Background

The ASMIS database contains information from Army ground mishaps reported in accordance with Army Regulation 385-40. The Commander of the mishap unit submits a DA Form 285 (U.S. Army Mishap Report) or a shaded DA Form 285 to report the mishap circumstances. The Aviation Life Support Equipment Retrieval Program at USAARL retrieves life support equipment from aviation mishaps to study the performance of the equipment in the crash environment. Equipment from ground mishaps is also provided to USAARL for further analysis. This information is used to detect performance problems, improper use of the equipment, and to guide design requirements for new life support equipment.

Impact standards for the current CVC helmet, as outlined in MIL-H-44117A (1990), requires that the helmet assembly shall not transmit an impact acceleration to a standard headform accelerometer in excess of 75 G when dropped from a height of 18 inches. These limits were obtained as a result of approximated human thresholds to concussion. In contrast, current aviation helmets such as the SPH-4B transmits less than 250 G acceleration with a 6 foot drop and newer flight helmets are expected to limit this to less than 175 G. In addition, the current CVC helmet's V_{50} ballistic requirement provides shrapnel protection for a standard simulated fragment projectile at 1400 feet per second. The PASGT helmet requires V_{50} ballistic protection for the standard fragment simulator at 2000 fps.

Materials and Methods

ASMIS Ground Database Information

A total of 20,818 vehicle mishap case records were extracted from the ASMIS ground database for the fiscal years 1984-1991. These records included injury data on 26,328 U.S. Army personnel and Department of the Army civilians. Among these database records were 2,902 records which represented all armored vehicle mishaps. Armored vehicle crewmembers injured in other vehicle mishaps (such as automobile, truck, or van accidents) were not included in this analysis.

A list of vehicles which employ the DH-132A was compiled from Janes Armor and Artillery (1984), and contacts in several armored units. In addition, a list of Military Occupational Specialty (MOS) titles of armored vehicle crewmembers was compiled from Army Regulation 611-201. (Department of the Army, 1987) These titles were cross-referenced with ASMIS data fields to verify consistency. A complete list of vehicles and MOS titles used in this report can be found in Appendix A.

For the purpose of this study an armored vehicle crewman was defined by the MOS of the soldier. All other persons were listed as passengers (MOS not reflecting armored vehicle duties). For each soldier we abstracted information from the ASMIS record about age, MOS, factors contributing to the mishap, and the reported injury (type, body location, and severity).

Only one injury is reported on the DA Form 285. This limits the amount of information available when multiple injuries are present. Information on the operating hours and/or miles driven by each type of armored vehicle was not available to determine mishap incidence.

Mishap Report Review

Due to the limited injury information in the ASMIS database, we performed a confirmation study to verify the number and severity of injuries to each soldier in a typical armored vehicle mishap. Records for 30 mishaps were randomly selected. Among this group, 17 mishaps included a completed DA Form 285 was present, we compared the information from Form 285 with the investigation report, and autopsy or emergency treatment records.

Vehicle Surveys

Vehicle surveys were conducted at the Unit Training Equipment Site at Fort Rucker and at the 1/29th Infantry Battalion at Fort Benning. The surveys included photographs of likely injury areas and informal interviews with combat vehicle crewmembers to learn about vehicle operations and procedures.

Results

ASMIS Database Study

In reported mishaps, 74 percent of the occupants in an armored vehicle were injured, and at least 20 percent of the occupants suffered head injuries. Among 2902 armored vehicle mishaps over an 8-year period, head injuries resulted in 31 deaths, and 643 non-fatal injuries. A comparison of head injuries among armored vehicle crewmembers wearing the CVC helmet and passengers is presented in figure 1.

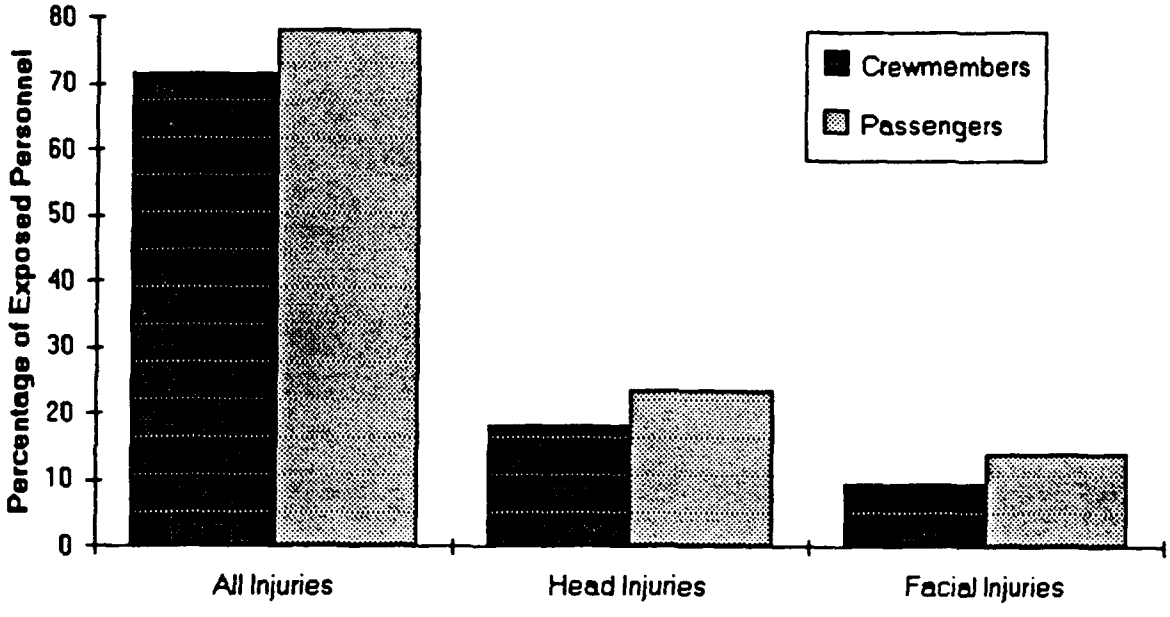


Figure 1. Injuries in armored vehicles for crewmembers wearing the CVC helmet and passengers wearing the PASGT helmet or no head protection.

Head and facial injuries were predominantly lacerations, fractures, concussions, burns or other injuries. These were evenly distributed among persons wearing the CVC helmet and passengers as detailed in Table 1. These mishaps resulted in more than 60,000 lost workdays, 15,000 for head and facial injuries, over the eight-year study period.

Table 1.

Comparison of number head and face injuries among crewmembers wearing the CVC helmet and passengers in armored vehicle mishaps.

Injury Type	Crewmembers (N=598)	Passengers (N=450)
Laceration	245 (41%)	217 (48%)
Fracture	122 (20%)	100 (22%)
Concussion	83 (14%)	45 (10%)
Burn	33 (6%)	18 (4%)
Other	115 (19%)	70 (16%)

Complete Mishap Report Review

Review of the 17 complete mishap reports showed at least two injuries were sustained by each individual involved in the mishap. The most severe injury is the injury reported to the USASC database.

Discussion

This retrospective review of information from the U.S. Army Safety Center Database provides an insight into the serious and sometimes fatal mishaps that occur with armored vehicles. Approximately 20% of the injuries among crew involved head injuries despite the use of a protective helmet. This result is not unexpected considering the impact protection specification for the current helmet. The ability to limit head acceleration to less than 75 G for an 18 inch fall would be expected to protect the wearer from the "bumps" expected in operating an armored vehicle, but is insufficient to protect the wearer from a significant impact. Impact protection for roll-over mishaps or falls to the ground would require a helmet that provides less than 175 G head acceleration for a 6 foot drop height (19.7 fps impact velocity). A new crew helmet should continue the specification for the repetitive "bump" protection, but also should include the ability to protect the wearer from a single significant impact similar to flight or motorcycle protective

helmets. No specific information on ballistic protection requirements was suggested by the data in the US Army Safety Center database.

The data portion of the current USASC mishap report could be improved by providing additional detail on more than one injury and the type of protective equipment worn. Failure to record this information in the current database and not reporting less serious mishaps leads to under reporting of head and facial injuries. The information in this study is limited to the most serious injuries and underestimates the head and facial injury problem. In addition, facial lacerations and broken teeth resulting from head and face strikes that do not result in lost workdays are probably not reported. A prospective or survey study of armored vehicle crewmembers is needed to clearly define the population at risk, the incidence of all types of injuries, and the mechanism of injury for each cause.

Other methods are available to reduce the number of head and facial injuries in combat vehicles. These include the use of restraint systems to reduce the individual strike envelope and the use of padded or frangible structures within the strike envelope. In the case of roll over accidents and sudden vehicle decelerations, proper restraint and improved padding of selected contact surfaces could greatly reduce the incidence and severity of injuries.

Conclusions

Approximately 20% of the 2902 serious armored vehicle mishaps resulted in head or facial injuries. Over the 8-year study period, this resulted in 31 deaths, 643 non-fatal injuries, and over 15,000 lost workdays for the U.S. Army. The types of head and facial injuries included lacerations, skull and facial fractures, concussions, and burns. Information sources used for this study would be expected to underestimate the magnitude of this problem. A prospective study of this problem could accurately define the head and face injury risk for armored vehicle crewmembers.

Head and face protection would be improved by maintaining the current "bump" protection in a new CVC helmet, but also including true impact protection for falls or roll-over mishaps. A recommended standard would be to limit head acceleration to less than 175 G for a 6-foot drop height.

In conjunction with an effort to improve protection with a new CVC helmet, other methods to reduce head injuries should be considered. For example, a careful study of each crew position strike envelope to determine if improved restraint, padding, or frangible structures could reduce injury.

References

Department of the Army. 1987. Army Regulation 385-40. Accident Reporting and Records. Issue No. 1. Washington, D.C.

Department of the Army. 1987. Army Regulation 611-201. Enlisted Career Management Fields and Military Occupations. Washington, D.C.

Department of the Army. Military Specification, Helmet, Combat Vehicle Crewman, Ballistic Shell. DH-132A; MIL-H-44117A Amendment 1. March 1990.

Janes' Armor and Artillery. 1983-1984. New York, NY. Janes' Publishing Inc.

Appendix A.

Vehicles evaluated for use of the Combat Vehicle Crewman Helmet

Vehicle Designator	Vehicle Nomenclature
M1/A1	Tank, Main Battle
M2/3	Bradley Fighting Vehicle
M60/A1,3	Tank, Medium
M113/A1,2,3	Armored Personnel Carrier
M551	Armored Reconnaissance
M557/A1,2	Armored Personnel Carrier
M901/A1	TOW Armored Carrier
M106	Carrier
M981 (FISTV)	Carrier
M973	SUSV LW Track
M163/A1	Vulcan Tracked Vehicle
M109/A1,2,3	Howitzer
M110/A2	Howitzer
M88/A1	Medium Recovery Vehicle
M578	Light Recovery Vehicle
M47	Tank
M48/A5	Tank
M103/A2	Tank

MOS Titles for Crewmembers in Armored Vehicles (list may not be inclusive)

MOS Classification	MOS Title
12A	Track Commander
12B	Combat Engineer
12C	Bridge Crewmember
12F	Engineer Tracked Vehicle Crewman
12Z	Combat Engineer
13A	Cannon Crewmember
13B	Cannon Crewmember
13E	Cannon Fire Detection Spec.
13F	Fire Supp. Spec.
15J	LANCE Crew
16P	CHAPARRAL Crew
16R	Vulcan Crew
17K	Radar Crew
19D	Cavalry Scout
19E	M48/60 Crewman
19K	M1 Crewman
19Z	Armor Sr. Sgt.
24M	Vulcan Mech.
27E	Dragon Repairer

27F	Vulcan Repairer
31G	Tact. Comm.
31V	Comm. Maint.
45D	Turret Mech.
45E	M1 Turret Mech.
45K	Tank Turret Repairer
45N	M60 Tank Turret Mech.
45T	Bradley Turret Mech.
63D	Artillery Syst. Mech.
63E	Heavy Constr. Oper.
63H	Track Veh. Repairer
63N	M60 Syst. Mech
63T	Bradley Syst. Mech.
63Y	Track Veh. Mech.
91A	Medical Spec.
91B	Medical NCO.